Detection and Measurement of Brain Tumor using Labview

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Abstract- The present study; describe the best brain tumor detection methods from the MRI (Magnetic Resonance Imaging) and CT (Computed Tomography) scans. Brain is the center of the human central nervous system which contains 50-100 billions neurons. Abnormal growth of cells in brain is called the tumor which can damage other cells that are important for functioning human brain. Due to complex structure of human brain, detection of tumor is a challenging task. To locate the exact position of the brain tumor various detection techniques can be used. MRI and CT scans are computer aided systems that are used for biological study. MRI uses the magnetic fields and radio waves and CT scan uses the X-rays to form the images of human body. The present investigation demonstrates the study of brain tumor detection using LabVIEW (Laboratory Virtual Instrumentation Engineering Workbench) techniques and methodologies, by providing the medical imaging techniques. The proposed study provides a comparative frame work of the method used over other methodologies.

Keywords- Brain, CT scan, Detection Techniques, MRI, Image Processing, Tumor

I. INTRODUCTION

Brain is the center of the nervous system in vertebrate and most invertebrate animals. Only few invertebrates such as jellyfish, starfish don't have a brain. Human brain has the same general structure as other mammals but with developed cerebral cortex. Average weights of human brain is 1.3 -1.4 kg or approximate 2% of total body weight. Many types of cells are present in the human body and each cell has special functions [1]. The "TUMOR" is a synonym for a "NEOPLASM" word which is produced by unusual enlargement of tissues. In brain tumor, cells grow uncontrollably inside or around the brain. According to the report of WHO (World Health Organization), now days tumor is the most common brain disease and it is classified in two types: i) Malignant or Cancerous ii) Benign or Non-cancerous. Cancerous tumor is further classified as i) Primary and ii) Secondary Tumors. Primary malignant tumor originates from the brain tissue and secondary malignant tumor spread from elsewhere in the body to brain and it is also called the brain metastasis [2]. Cancerous tumor is more harmful as compared to benign tumor because it spread rapidly in irregular shape. If the growth of extra cells becomes more than 50%, then possibility of recovery of patient is optimum. Development in medical imaging techniques provides the more opportunity to detect the problems. MRI and CT scan are the most frequently used imaging techniques in neuroscience which providing the deep structure of the brain by creating the 3D images.

CT scan: Computerized axial tomography and X-ray computed tomography are the other names of CT. CT scan use combination of many X-ray images to produce the tomographic images of a specific area [3].

MRI: MRI used in the radiology to examine the physiology and anatomy of the body in both cases in health and disease. MRI use magnetic waves and radio waves in place of ionizing radiation as in the case of CT scan and MRI offers better visualization than CT scan and more sensitive for small tumors [4]. MRI detects the differences in the cells by providing finer details information of the internal structure of body. Resolution of MRI is approximately 100 microns which gives the better result than the other methods [5].

K. Sudharani et al developed a script in NI Vision Assistant using LabVIEW to detect area and length of the brain tumor in CT and MRI scan images Color plane extraction technique is applied to remove red plane and thresholding and FFT filters are used to detect the exact location of brain tumor. In next step, measurement techniques are used to calculate the area and length of tumor [6]. Dr. Fakhraldeen H. Ali use Fuzzy Image Processing (FIP) with Vision and Motion toolkits of the LABVIEW to detect the brain tumor. With the help of fuzzy filters noise is removed from the image [7]. The manuscript is organized as: section2 presents symptoms, causes and effects of brain tumor, section3 demonstrates proposed mode of the study, and section 4 describes implementation and results following by conclusion and remarks.

II. SYMPTOMS, CAUSES & EFFECTS OF BRAIN TUMOR

The oldest brain was exposed in Armenia in Areni-1 cave complex. The brain was found in the skull of a 12-14 years old girl and was approximate to be over 5,000 year old [8]. The creator of the atomic theory of matter gives explanation about three-part soul, by intelligence in the head, sentiment in the heart, and hunger near the liver. The opening valid growth toward a current accepting of nervous role, although, came after the investigations of Luigi Galvani [9], who revealed that a shock of static electrical energy applied to an exposed nerve of a dead frog may perhaps reason its leg to contract. Golgi Stain [10] explores stains that are small portion of neurons in his research. Without a stain, brain tissue in a microscope appears as tightly packed knot of protoplasmic fibers, in which it is unfeasible to resolve any structure. Neuro-anatomist Santiago Ramón y Cajal [11] elaborate that the new stain exposed hundreds of different types of neurons, with its personal matchless dendrites composition and model of connectivity. In 1942, Charles Sherrington [12] visualized the mechanism of the brain waking from sleep. "Decade of the Brain" is celebrating in 19990s because of advancement in brain investigation, and to support financial support for such investigation [13]. These trends are also continuous in 21st century, and numerous fresh approaches have come into fame, as well as multi-electrode recording, which allow the movement of various brain cells to be recorded at the identical time.

All kinds of brain tumors may create symptoms that are based on the fraction of the brain occupied. These may contain headache, seizures, difficulty through vision, vomiting, mental changes, memory loss, lack of gratitude, spatial orientation disorders, sentiments change, impaired intellect of smell, impaired audible range, facial paralysis, double vision, dizziness, but extra strict symptoms might take place too, such as paralysis on one side of the body hemiplegia or impairment in swallowing. The headache is typically most terrible in the morning and goes away by way of vomiting. Additional precise trouble may contain complexity in walking, speaking and with sensation. These signs are not exact for brain tumors – they due to a huge diversity of neurologic circumstances [14].

From experience to ionizing radiation, there are no identified environmental factors related to brain tumors. Mutations and deletions of so-called tumor suppressor genes, such as P53, are consideration to be the reason of several forms of brain tumor. Multiple endocrine neoplasia, and neuro-fibromatosis type2 carry a high risk for the growth of brain tumors [15]. According to the study, any connection between cell phone radiation and the happening of brain tumors is not exposed.

The research of the National Brain Tumor Foundation provides that in United States out of 29000 patients, the estimated death due to brain tumor is 13000. Primary brain tumors happen in around 250,000 persons a year worldwide, making up a lesser amount of than 2% of cancers [16]. The most recent data issued by the National Cancer Registry Program of the India Council of Medical Research (ICMR) has undoubtedly revealed that cancer has grow up to be most important cause of loss of live in India with 1,300 deaths every day, and nearly 5 lakhs each year. The data released in May, 2015 displays an approximate 6% increase in death rate because of cancer from 2012 to 2014. In a press note on Brain Tumor by Dr. Sajal Kakkar, Consultant Radiation Oncologist, Apollo Cancer Hospitals, Hyderabad on June 6, 2015 about 18,000 latest cases of primary brain tumors are detected every year in India according to the recent data [17]. The brain tumors rank 7th or 8th for the occurrence in a range of cancer registries of our nation.

III. PROPOSED METHOD

The proposed method to detect the brain tumor, an image from CT scan or MRI scan is acquired. Tumor usually has more concentration than other part of image and a script is developed using IMAQ (Image Acquisition) Vision and Motion Toolkits and NI (National Instruments) Vision Assistant toolkits of LabVIEW to detect the tumor.

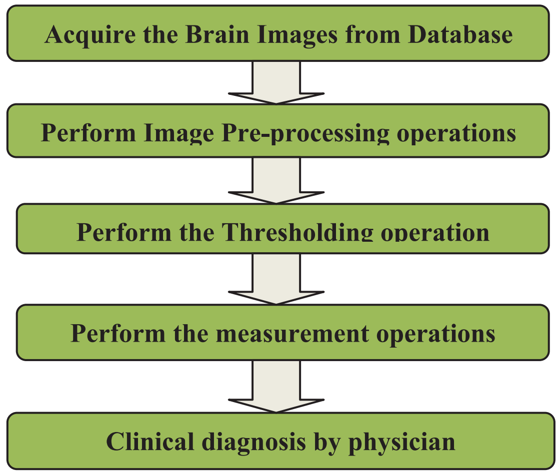


Fig.1. Flow Chart of Tumor Detection Technique

Fig.1 show processing steps of the tumor detection techniques and these steps are implemented using LabVIEW software which is shown in Fig.2 in the form of proposed model of tumor detection technique.

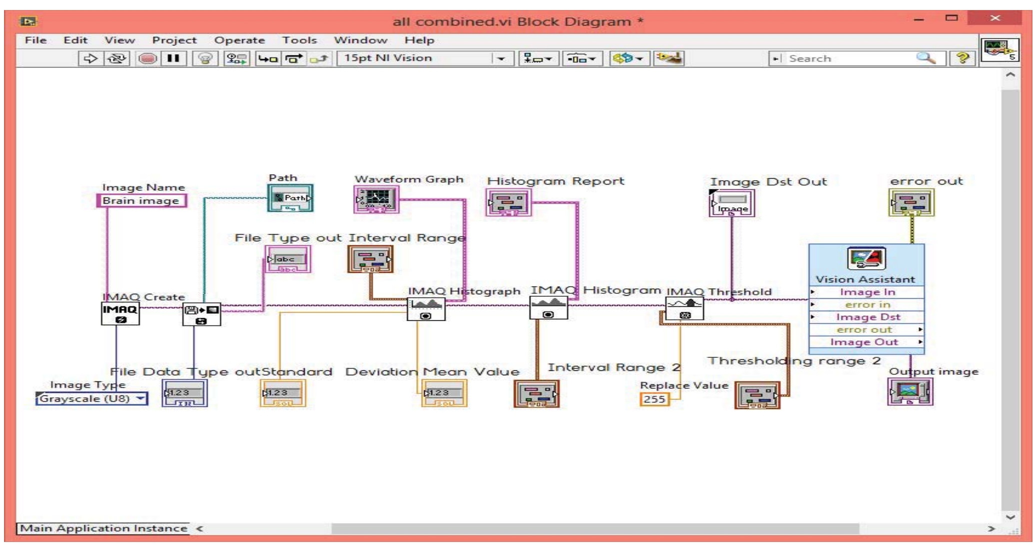


Fig.2. Proposed Model of Tumor Detection Technique

1. Acquire the Brain Image: First step in this process, is acquiring the image of brain that are stored in database or in image file and displayed the equivalent as a gray-scale image. The entries of a gray scale images are ranging from 0 to 255, where 0 represents complete black color and 255 represents pure white color. Images are collected from different sources of different patients and stored in database. Select one of image from the database and perform the operation to detect the tumor area, location and position. Model shown in Fig.3 is used to acquire the images from database.

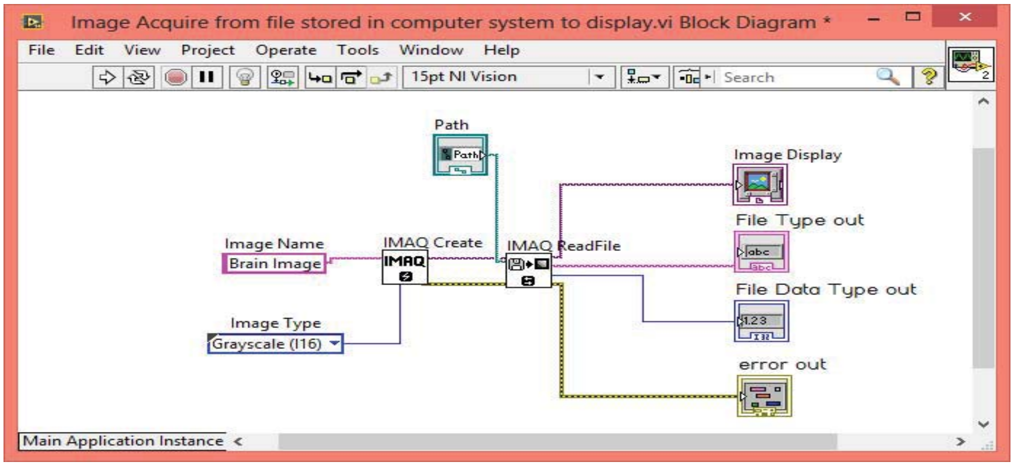


Fig.3. Model to acquire the image

2. Image Pre-processing: Preprocessing techniques are used to get better result for the detection of the doubtful section from MRI and CT scan image.

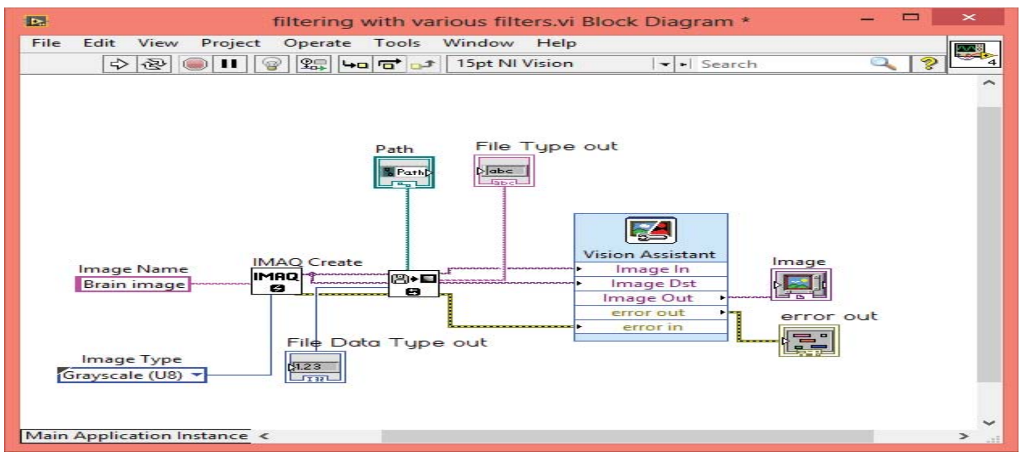


Fig.4. Model to Filter the Image

The acquired image consists of noise and low down contrast is may not be superior for inspection. To overcome noise, and low contrast, pre-processing of image is essential to get finer details of improved image. Fig.4 show the model of filtering that performed the smoothing and sharpening operation with image.

Image Smoothing: Filters may be used to eliminate the noise from the images to make it smoother. The standard deviation of the filters can be varied to adjust degree of smoothening. The simplest low-pass filter calculates the average of a pixel and all of its eight instant neighbors to replace with the actual value of the pixel. A filter is clear by a kernel, which is a little array applied to each pixel and its neighbors inside an image. For the low pass filter, 3*3 Kernel is expressed in fig.5 as:

$$\begin{bmatrix} +1/9 & +1/9 & +1/9 \\ & & \\ & & \end{bmatrix}$$

+1/9 +1/9 +1/9
+1/9 +1/9 +1/9

Fig.5. Kernel Size of Low Pass Filter

When the kernel is applied, each pixel and its eight neighbors are multiplied by 1/9 and added together. The pixel in the center is replaced by the sum and this operation is repetitive for each pixel in the image. The filter is centered on p5 which is the center pixel in the pixel window as shown in fig.6 and the formula to calculate the resulting new p5 pixel is defined as:

Newp5= (p1*1/9+p2*1/9+p3*1/9+p4*1/9+p5*1/9+p6*1/9+p7*1/9+p8*1/9+p9*1/9)

$$\begin{bmatrix} \mathbf{p1} & \mathbf{p2} & \mathbf{p3} \\ \mathbf{p4} & \mathbf{p5} & \mathbf{p6} \\ \mathbf{p7} & \mathbf{p8} & \mathbf{p9} \end{bmatrix}$$

Fig.6. Pixel Window

b. Image Sharpening: Sharpening of the image can be achieved by various high pass filters. A high pass filter keeps the high frequency information inside an image whereas minimizing the low frequency information. The kernel of the high pass filter is designed to magnify the clarity of the middle pixel comparative to neighboring pixels. The kernel array contains a single positive value at its center, which is entirely enclosed by negative values. An example of a 3*3 kernel for a high pass filter is shown in fig7:

$$\begin{bmatrix} -1/9 & -1/9 & -1/9 \\ -1/9 & +8/9 & -1/9 \\ -1/9 & -1/9 & -1/9 \end{bmatrix}$$

Fig.7. Kernel Size of High Pass Filter

There are various edge detection filters such as Canny edge detection, Sobel edge detection, Roberts edge detection, and Prewitt edge detection which are used to detect the boundary of tumor. By selecting one of the edge detection filters from the **Filters** list to experiment with different coefficients and the **Kernel size** to get the results accordingly.

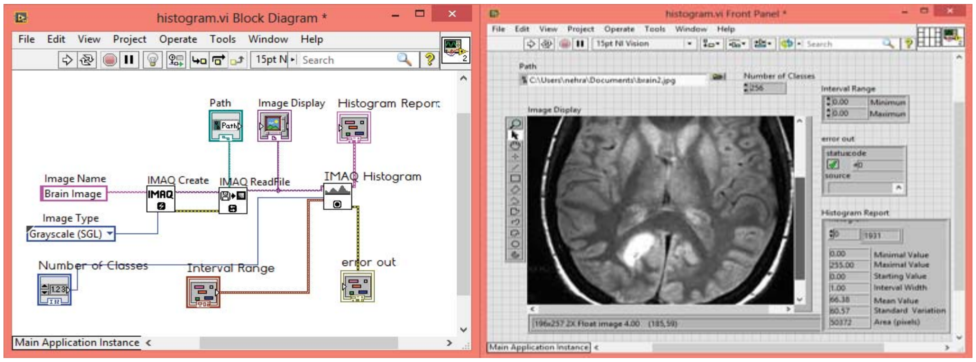
c. Contrast Enhancement: The simplest way to modify an image is to apply changes to its gray-level values. IMAQ Vision provides two easy tools for the distribution of gray-level values (intensity of image).

i. Histogram
ii. Histograph

In this system, enhancing the contrast of images is done by changing the values in intensity of image, such that the histogram of the output image almost matches a particular histogram or this may be achieved by varying the gray-level values (g) of pixels by conveying a new value to each pixel. Tumor has already extra contrast from the other part of the image so there is no need of increase the contrast of image. These functions are only used to get or extract the features of image.

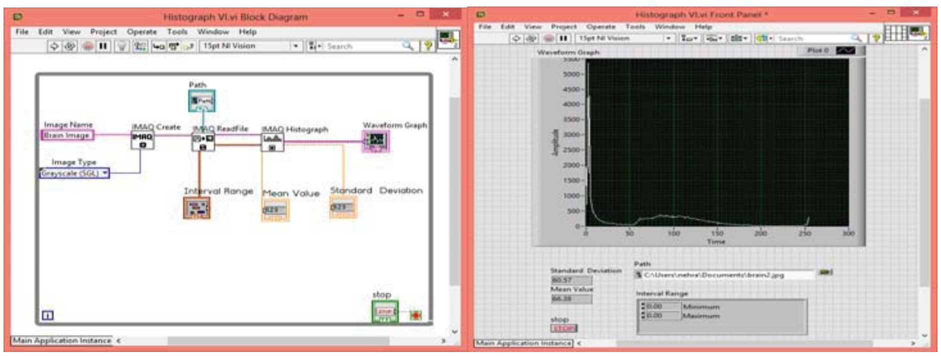
Histogram: The histogram gives the numeric information about the distribution of the numeral of pixels per gray-level value that is show in fig.8. The Histogram function analyzes the image and shows information for examination.

Histograph: This function shows the histogram information in a waveform graph. Histograph is a graphical version of the distribution of data as shown in the fig.9. This graphical version is similar to a bar chart in arrangement, organizes a cluster of data points into user-specified ranges.



(a) (b)

Fig.8. (a) Histogram Model and (b) Output



(a) (b)

Fig.9. (a) Histograph Model and (b) Output

3. Thresholding Operation: Image thresholding is the most vital task of image analysis. The thresholding is significant as well as essential to take apart the region in which more attention is paying from the background.

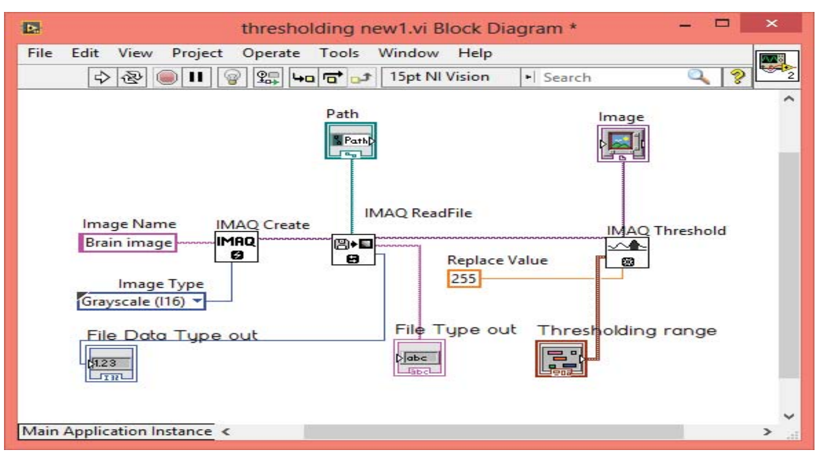


Fig.10. Thresholding Model

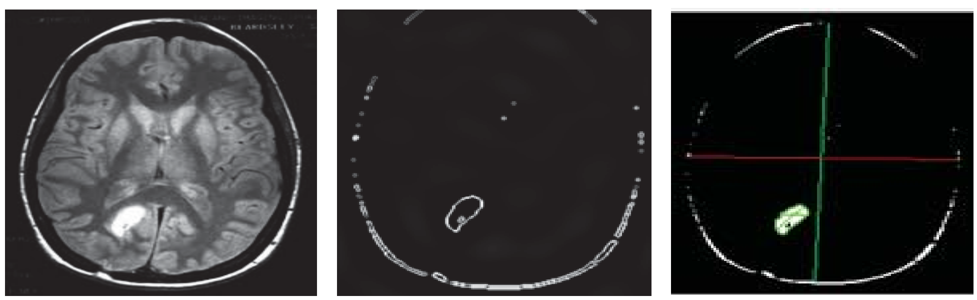
The pixels having extra intensity value than the thresholding value set the same as white output and rest with black. The input gray scale image is renewed into a binary format with the aid of thresholding. By choosing a proper threshold T, to partition image pixels into numerous regions and split objects from background. Any pixel (x, y) is measured as an element of tumor if its intensity is greater than or equal to threshold value i.e., $f(x, y) \geq T$, besides pixel fit in the background. Fig.10 is given below which show the thresholding operation.

4. Measurement: After completing the above given operations, we can perform the measurement operations to find the length and area of the tumor. The measurement is mainly absolute in the SI system, and which have seven basic units such as kilogram, meter, and candela, second, ampere, Kelvin and mole.

5. Clinical Diagnosis by physician: After saving the measurements of the length and area of tumor report is given to the physician for the better treatment of the patient.

IV. IMPLEMENTATION & RESULT

To test the effectiveness of the proposed scheme tests it on three different real brain MR Images. This image Fig.11 (a) can be original image. Now we sharp and enhance the image using filters and get the edge of image with high brightness. After that histogram measurement operation is performed using the histogram tool. Then resulting image is send for thresholding using local thresholding value, and this is shown in Fig.11 (b). By edge detection we get fine edges of gradient magnitude. Now we apply measurement operation with the help of Measure tool in Vision Assistant toolkit and gets result as shown in fig.11(c).



(a) (b) (c)

Fig.11. Case1 (a) Original Image, (b) After Processing and (c) Measurement

Fig.12. Case2 (a) Original Image, (b) After Processing and (c) Measurement

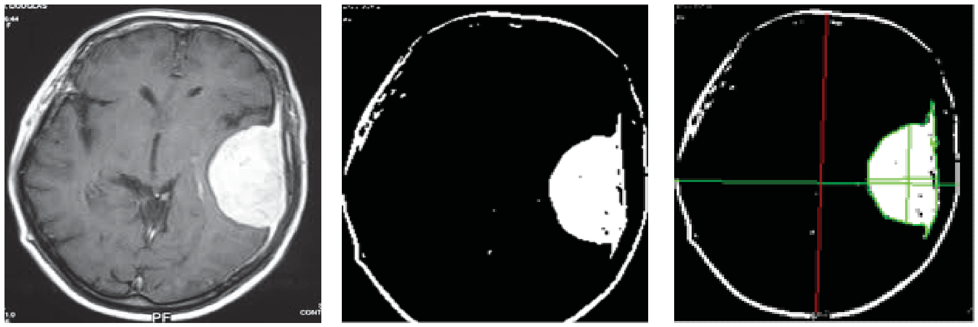


Fig.12. Case2 (a) Original Image, (b) After Processing and (c) Measurement

As similar to the case1, apply algorithm on other real MRI brain image with 256 * 256 slices which are shown in fig.12 and fig.13 and perform the measurement operations.

TABLE I: HISTOGRAM REPORT

	Case1	Case2	Case3
Minimum Value	**0**	**5**	**8**
Maximum Value	**255**	**255**	**255**
Starting Value	**0**	**0**	**0**
Interval Width	**1**	**1**	**1**
Mean Value	**67.08414**	**89.18237**	**108.0761**
Standard Deviation	**59.50094**	**62.58606**	**65.75077**
Area (pixels)	**50372**	**50481**	**50430**

TABLE II: AREA & LENGTH MEASUREMENT

	Case1	Case2	Case3
Area of Tumor	**406**	**1199**	**3207**
Length of Tumor in Vertical Direction	**26.62705**	**46.2277**	**75**
Length of Tumor in Horizontal Direction	**13.60147**	**30.4795**	**49.0102**
Pixel Ratio of Tumor in %	**0.806**	**2.37515**	**6.35931**
Length of Brain in Vertical Direction	**238.0021**	**228.0548**	**238**
Length of Brain in Horizontal Direction	**173.0029**	**190.0947**	**189.0026**

TABLE III: MEAN VALUES MEASUREMENT

	Case1	Case2	Case3
Mean Value of the Tumor Area	**0.8399**	**0.88407**	**0.93234**
Mean Value of the Tumor Length in Vertical Direction	**1**	**0.91667**	**1**
Mean Value of the Tumor Length in Horizontal Direction	**0.92308**	**0.82609**	**0.91837**
Mean Value of Brain in Vertical Direction	**0.0042**	**0.14912**	**0.02521**
Mean Value of Brain in Horizontal Direction	**0.00578**	**0.01053**	**0.2328**

TABLE IV: STANDARD DEVIATION MEASUREMENT

	Case1	Case2	Case3
Standard Deviation of Tumor Area	**0.3667**	**0.32014**	**0.25117**
Standard Deviation of Tumor Length in Vertical Direction	**0**	**0.27639**	**0**
Standard Deviation of Tumor Length in Horizontal Direction	**0.26647**	**0.37903**	**0.2738**
Standard Deviation of Brain in Vertical Direction	**0.06468**	**0.35621**	**0.15676**
Standard Deviation of Brain in Horizontal Direction	**0.07581**	**0.10206**	**0.42262**

Table I to IV presents the measurement result as table I demonstrates histogram measurement of brain images, table II describes the detail of area and length of tumor and brain, table III explain the mean value measurement as well as table IV represents the standard deviation values of tumor portion and brain images.

V. CONCLUSION

As diagnosis tumor is a complex and sensitive task; so, correctness and reliability are always assigned much importance. For accurate analysis of tumor patients, suitable filtering and thresholding method is necessary to be used for MR images to carry out a superior diagnosis and treatment. There is no commonly accepted method for image smoothing, as of the result of image is affected by lots of factors. Thus there is no single method which can be considered good. Due to these characteristics of MR images, local thresholding is used for tumor detection in which thresholding value can be changed to get the accurate tumor position. Due to the less steps requirement for tumor diagnosis, proposed algorithm is simple and less time consuming. There is not a fixed threshold value for all MRI & CT scan images and due to this computational time of the presented schema is increased. Because we need some extra time to set the threshold value for each image. Our future work is now focusing on the reduction of time complexity due to the changing thresholding value.

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