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Identification of Tumors Using Gamma Correction Based Image Enhancement of Brain MRI Images for Efficient Detection

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Abstract : *Segmentation of anatomical regions of brain is that the elementary problem in medical image analysis. The aim of this work is to style an automatic tool for tumor quantification mistreatment imaging image information sets. A tumor segmentation methodology must be developed and validate segmentation on 2nd & 3D imaging information. This methodology doesn't need associate the degree data format whereas the others need an data format within the growth. In this, when a manual segmentation procedure the growth identification, the investigations has been created for the potential use of imaging information for up brain tumor form approximation and 2nd & 3D mental image for surgical designing and assessing tumor. Surgical designing currently uses each 2nd & 3D models that integrate information from multiple imaging modalities. Firstly, the work was carried over to observe the growth in single slice of imaging information set so it absolutely was extended to observe and calculate the degree of the growth from multiple image imaging information sets. There square measure 3 strategies of segmentation. they're Snakes (Gradient Vector Flow), Level Set Segmentation and Watershed Segmentation Among all potential strategies for this purpose, watershed will be used as a strong tool that implicitly extracts the growth surface. Watershed segmentation based mostly formula has been used for detection of growth in 2nd and in 3D. For detection of growth in 2nd the code used is MATLAB. Except for detection of growth in 3D, the code used was MATLAB and 3D Slicer. 3D Slicer was wont to produce the 3D image mistreatment axial, saggital and flower arrangement pictures. This 3D image was then employed by MATLAB to observe the growth in 3D. The mental image and quantitative evaluations of the segmentation results demonstrate the effectiveness of this approach.*

Keywords - *tumor; gamma correction; enhancement; morphological operations.*

I. Introduction

As reported in (NCIS) National cancer Institute statistics the overall incidence of cancer over the last 20 years, including the brain cancer, has increased more than 10%. As the last 5 years 2008-2012 the number of new cases of cancer & deaths of Central nervous system (CNS) and brain cancer was 6.4 per 100,000 men & women and 4.3 4 per 100,000 men & women per year respectively. For Brain and other nervous system cancer, 76.6% are diagnosed at the local stage. However, the rate of cancer in men is slightly more than women and among those with certain genetic syndrome The **brain** is an organ that serves as the center of the nervous system in all vertebrate and most invertebrate animals—only a few invertebrates such as sponges, jellyfish, adult sea squirts and starfish do not have a brain, even if diffuse neural tissue is present. It is located in the head, usually close to the primary sensory organs for such senses as vision, hearing, balance, taste, and smell. Brain tumor detection is an application of Magnetic Resonance Imaging. Brain tumor detection is an area characterized by the need for extensive experimental work to establish the viability of proposed solutions to a given problem. In this chapter, we outline an overview of Brain, Brain tumor its detection, risk factors, signs and symptoms and diagnosis to understand in a better way how a cancerous (malignant) is caused.

1.1 Anatomy of Human Brain

The brain is one in every of the biggest and most complicated organs within the flesh. it's created from quite one hundred billion nerves that communicate in trillions of connections referred to as synapses. The brain could be a soft, spongy mass of tissue. The brain is encircled by a layer of tissue referred to as the tissue layer. it's protected by:

- The bones of the os.
- Three skinny layers of tissue (meninges).
- Watery fluid (cerebrospinal fluid) that flows through areas between the tissue layer and thru areas (ventricles) among the brain.

1.1.1 Lobes of Brain

The brain is additionally divided into many lobes:

- The frontal lobes square measure to blame for downside finding and judgment and motor operate.
- The membrane bone lobes manage sensation, handwriting, and body position.
- The temporal lobes square measure attached memory and hearing.
- The bone lobes contain the brain's visual process system.

1.1.2 Structure of Brain

The Brain is formed from several specialised areas that job together:

- The cortex is that the outmost layer of brain cells. Thinking and voluntary movement begin within the cortex.
- The Brain stem is between the funiculus and therefore the remainder of the brain. Basic functions like respiration and sleep square measure controlled here.

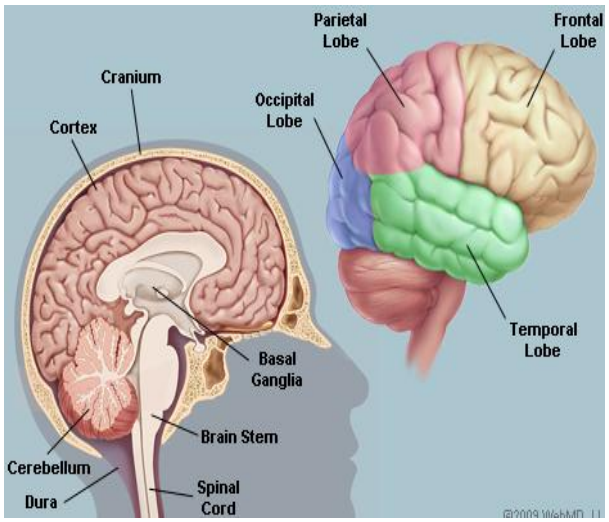

Figure1.1 Structure of Brain

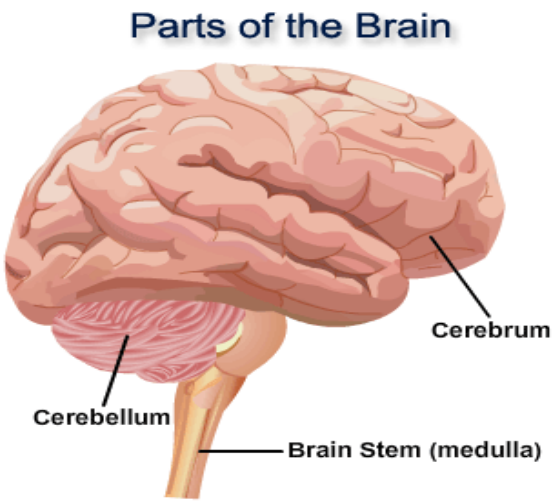

Figure1.2 Major parts of brain

1.1.3 Major Parts of Human Brain

The above figure (1.2) shows the major parts of the brain. The three major parts of the brain control different activities:

1. Cerebrum
2. Cerebellum
3. Brain stem

- Cerebrum: The cerebrum can be used the information from the senses to tell us what is happening on around us and say to our body how to respond. It controls reading, thinking, learning, speech, and emotions. The cerebrum is divided into:

a) The left cerebral hemisphere
b) The right cerebral hemisphere

The right cerebral hemisphere can be control muscles on left side of body. Moreover, the left hemisphere can control muscles on right side of body.

- Cerebellum: The cerebellum controls balance for walking and standing, and other complex actions.
- Brain stem: The brain stem has connected to brain with spinal cord. It can control breathing, body temperature, blood pressure, and other basic body function.

1.2 Brain Tumor

A neoplasm or intracranial tumor happens once abnormal cells kind at intervals the brain. a bunch (mass) of abnormal cells that starts within the brain. There square measure over one hundred twenty differing types of brain tumors, that makes effective treatment sophisticated. Once multiple traditional cells could become old or broken or die, so new cells can takes place. Sometimes, the method has gone wrong. New cells from the body don't want them, and broken or previous cells don't die they need to. The buildup of the additional cells could usually forms mass of the tissue referred to as neoplasm may be a localized intracranial lesion that occupies house tends to cause an increase in intracranial pressure. Diagnostic tools include: patient history, a brain scan, CT scan, MRI. There square measure 2 main styles of tumors: nonmalignant tumor and tumor or

Cancerous tumors are often divided into primary tumors that started at intervals the brain and people that unfold from elsewhere referred to as brain metastasis tumors; this text deals chiefly with primary tumors.

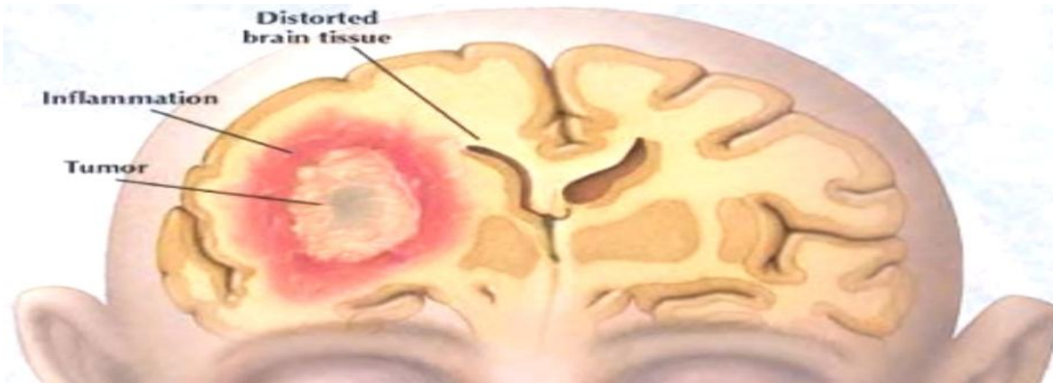

Figure 1.3 Brain tumor

1.2.1 Tumor Grade

The Doctors set brain tumors are displayed the by grade. The grade of tumor can refer the path of cells look under the microscope:

- Grade I: In this, the tissue can be benign. All the cells are look nearly such as normal brain cells, or they slowly grown.
- Grade II: In this, the tissue can be malignant. The cells may look less than normal cells do cells in the Grade I tumor.
- Grade III: In this, the malignant tissue contains cells which look much different from the normal cells. other abnormal cells has actively grown.
- Grade IV: In this grade, the malignant tissue contains cells look most the abnormal and tends to grow up quickly.

1.2.1 Classification of Brain Tumor

There are two main types of tumors:

a) Benign tumor:

- It is non- cancerous cell.
- It can be removed easily, and they seldom grow back.
- It does not invade the tissues around or spread them into other parts of body.
- Its growth rate is slow.

b) Malignant tumor:

- It is a cancerous cell.
- It can be challenging to be removed and life threatening.
- It invades tissues around or spread them into other parts of body
- It spreads very quickly.

1.2.3 Types of Primary Brain Tumors

There are several types of main brain tumors. The main brain tumors have been named according to type of the cells or part of brain in that they begin. E.g. multiple primary mind tumors may start in glial cells. This tumor is called a glioma. Among the adults, the normal common types displayed are:

- Astrocytoma: The tumor may arise from the star-shaped glial cells which is called astrocytes. This can be part of any grade. In the adults, an astrocytoma has most arises in cerebrum.
- Grade I and II astrocytoma: It can be known as low-grade glioma.
- Grade III astrocytoma: It is sometimes known as anaplastic astrocytoma.
- Grade IV astrocytoma: It can be known a glioblastoma or MAB.

1.3 Magnetic Resonance Imaging (MRI)

A number of different imaging techniques are developed to study Tumors such as Computed Tomography (CT), Positron emission tomography (PET), Magnetic Resonance Imaging (MRI), Single photon emission computer tomography etc. Currently, CT and MRI are the most widely used techniques because of their High resolution images ability. Magnetic Resonance tomography is a medical imaging technique used by

radiologists to visualize the internal structure of human body in detail. MRI can create more detailed images of human body than possible with X-rays.

1.4 Motivation

Out of 5 senses touch, sight, hearing, smell and taste, that humans can be used to perceive the environment, sight is much powerful. Taking and analyzing the images forms a huge part of routine the cerebral activity of the human beings throughout their waking lives. Actually, more than 99% of activity of human brain is included in the processing images from visual cortex. The visual image is high in information. Confucius told, "A picture is worth a thousand words."

1.5 Basic Image processing

The detection of tumor requires image processing operations therefore it is important to discuss about the concepts of image processing. For a binary image, white pixels square measure ordinarily taken to represent foreground regions, whereas the black pixels denote background. Then the set of coordinates appreciate that image is just the set of the two-dimensional geometer coordinates of all the foreground pixels within the image, with the origin ordinarily taken in one amongst the corners so all coordinates have positive components. Following the binary conversion, also known as thresholding, the process is followed by morphological operations in order to segment out the affected region. The methodology section will be discussing the topics in details.

II. Literature Review

Balaji et al (2015) In this paper the tumor is detected and classified the stages of tumor by using testing and training the database [1]. Sharma et al (2014)

In this paper different techniques are studied to detect the tumor from Brain MR image and it is concluded that a method which performs well for one MRI image may not perform well for the other image. So, it is hard to achieve a general method that can be used for all MRI images. Thus the demerits and merits of different techniques based on brain tumor identification are analyzed [2].

Senthil kumaran N et al (2014) proposed an image histogram based enhancement equalization method which is compared for enhancement like the contrast of MRI Brain image. In this paper, the more popular techniques of Histogram equalization methods like Global Histogram Equalization (GHE), Local histogram equalization (LHE), Brightness preserving Dynamic Histogram equalization (BPDHE) & Adaptive Histogram equalization (AHE) are compared using different objective quality measures of MRI brain image enhancement [3].

Zeljkovic et al (2014) In it this Brain MR image is acquired first then sharpened by enhancing its contrast. Then with the help of segmentation technique the tumor part is detected [4].

Shah et al (2014) In this paper the high quality image data of Medical image is maintained with the help of efficient servers across the network. The images are compressed with zero data loss while transmitting and storing the images. Thus this paper represents a compressed method based on region of interest, its performance analysis focusing on Haar wavelet transformation technique [5].

Rani et al (2014) Histogram equalization based contrast enhancement techniques are widely implemented in this paper. In it recursive segmentation of histogram is done and then weighted method is applied to smooth the histogram and then gamma correction is used to improve the brightness of the image [6]. Preetha et al (2014) Medical pictures usually contain noise and uncertainty thus segmentation performance to the amount of clinical acceptance is difficult. FCM shows sensible performance leads to segmenting the tumor tissue. The accuracy of tumor segmentation is known by implementing SVM classifier. The tactic offers superior results for potency and convergence rate [7].

Parameshwari et al (2014) planned AN economical algorithmic rule supported higher order cumulate Kurtosis to derive textural parameters in conjunction with 2-D rippling constant energies of the sub-bands victimization 2-level decomposition and by exploiting blessings of upper order cumulates and multi-scale rippling illustration. This theme conclusion within the reduced feature set the scale thus getting the necessity for victimization specialized characteristic choice or reduction algorithms [8].

Tamilselvan et al (2013) proposed an image fusion algorithm based on segmentation region. It combine effectively the pixel-level and feature-level fusion method. This results that the fusion performance is better [9].

Liu et al (2013) planned newest novel algorithmic rule to regulate the paired SNP-array knowledge from the each tumor and matched traditional samples which will produce the most effective use of genotype knowledge to observe the zero detection. The algorithmic rule uses the applied mathematics framework of the EM and HMM technique to the exactly model of relationship between the traditional tumor and tumor SNP-

array knowledge. The results incontestable the validity of those models and therefore the potency of the total applied mathematics framework, together with parameter estimation and aberration detection [10].

Ulku et al (2013) In it preprocessing Histogram Equalization technique is used to make explicit the mass that can be tumor [11].

Huang et al (2013) developed a novel enhancement technique for both images and video sequences which composed of three techniques. The first one is the Histogram analysis which gives the spatial information of a single image based on probability and statistical inference. The second one is the weighting distribution to smooth the fluctuant phenomenon. In the final step gamma correction is used which automatically enhances the image contrast with the help of smoothen curves. In future work the computational time for a number of image frame of a video sequence can be reduced [12].

Ibrahim et al (2013) the paper proposed Neural Network technique, consist of three steps, preprocessing, dimensionality reduction and classification. The implemented technique is fast in execution, efficient in classification and easy in implementation [13].

Subashini et al (2012) In it an sweetening and segmentation technique is predicated on a model of pulse coupled neural network and back propagation network has been enforced and tested on adult male brain image. This new application of PCNN and BPN leads to higher segmentation of images [14].

Yao-Tien Chen (2012) proposes an approach integrating 3D Bayesian level set method with volume rendering for brain tumor and tissue segmentation and rendering [15].

Bhattacharjee et al (2012) planned a replacement technique foe tumor detection from unhealthy adult male pictures is developed in it. It may enhance the potency of the detection and would stretch it to any illness classification [16].

Ghanavati et al (2012) has developed AN automatic tumor detection algorithmic rule victimization multi-modal MRI. The preliminary results show 100% detection rate all told of our check sets together with simulated and patient knowledge with a mean accuracy of ninetieth. This result conjointly shows that the form deformation feature will improve the segmentation accuracy [17].

Krishnan et al (2012) considerations regarding extracting tumor from MRI brain pictures victimization image process, segmentation, morphological operations and subtraction. a number of the morphological operators which will amendment the structuring parts of a picture in line with their use square measure open, spur, dilate and shut has helped in extracting the tumor from the MRI brain image. This offers the precise form of the tumor in this MRI image and eventually detection of tumor in MRI image is achieved [18].

Chiu et al (2011) presents a Novel Enhancement method which consists of three stages mainly. These are- Histogram analysis, Weighting distribution and the Gamma correction. The Histogram analysis will provide the information of single. Image based on the probability and statistical inference. The next stage will deal with smoothening to avoid generation of unwanted artifacts [19].

Dubey et al (2011) planned the comparison of various semi-automated techniques viz., victimization the changed gradient magnitude of region growing technique, the amount set and marker management watershed technique has undertaken at here to gauge the relative performance in segmentation of the tumor. The results show that space measurements obtained victimization MGMRGT technique is in sensible agreement with manually mesmeric knowledge [20].

Aka et al (2011) In it tumor segmentation and Detection is finished victimization adult male pictures. To planned technique increased the adult male image and segments the tumor victimization world thresholding. Experimental shows that this technique performs well in enhancing, segmenting and extracting the tumor from MRI pictures [21].

Viji et al (2011) use watershed segmentation technique at the specified parameters, which ends up that watershed phaseation is that the best method to segment a tumor in MATLAB, provided the parameters square measure set properly [22].

Badran et al (2010) In it a replacement system is planned which will be used as a second call for the surgeons and radiologists. In it 2 sets of neural network had to be trained. The input options for the primary set were supported cagy edge detection, whereas the input options to the second set were supported adaptive thresholding. It determines whether or not AN input MRI brain image represents a healthy brain or tumor brain as proportion. Any it defines the tumor type; malignant or neoplasm [23].

Gopal et al (2010) planned the intelligent system that has been designed to research the tumor via MRI whereas victimization a picture process cluster algorithms like Fuzzy C meaning together with the intelligent improvement tools, like as Genetic algorithmic rule, together with Particle Swarm improvement. This results the common classification error of GA is zero.078%. The common accuracy GA is eighty nine.6%. PSO offers best classification accuracy and average error rate [24].

III. Methodology

3.1 Proposed Methodology Gamma Law Correction

To improve the approach of morphological operations for segmentation of neoplasm at intervals the imaging footage, gamma law correction is planned to be implemented therefore on initial methodology and enhance the digital image so on differentiate the image constituent values significantly therefore on enhance the quality of the image. The improved image can then be served for morphology based image segmentation to get the growth region. The tactic of gamma correction will facilitate segmenting the growth region with absolute or near space and so the better-known region is segmental efficiently. The thought of gamma could also be applied to any nonlinear relationship.

1. For power-law relationship, curve on a log–log plot could be a line, with the slope everyplace adequate to the gamma (slope is displayed here by by-product operator):
2. The last step offers base to morphological segmentation in order that input image is alter to differentiate the various color levels or element values. Currently the appliance of morphological segmentation has been expected to be providing improved results.

To discuss the constraints of these some ways, how ought to have developed to make equal balance between the low method costs and high levels of visual quality. A hybrid metric linear unit technique has been projected to check this goal by effectively combining the THE and TGC schemes. it's indicated that in description of RSWHE technique, a gamma perform has accustomed modify each sub-histogram to involve the multi-equalizations with the brightness preservation. tho' the updated sub-histograms might lose little or no math knowledge so reduces the results of improvement. it's galvanized by the RSWHE schemes that directly used the cdf and apply a gamma perform to vary the curve transformation whereas not getting the offered bar chart of the statistics. considerably, the gamma parameter creates plenty of vital adjustment. The observation has semiconductor diode North yankee country to assign a paid cdf as adaptive parameter that changes the intensity of progressive increment with its original trend. The adaptive gamma correction has been developed as follows:

$$T(l) = l_{max}(l/l_{max})^{\gamma} = l_{max}(l/l_{max})^{1-cdf(l)}.$$

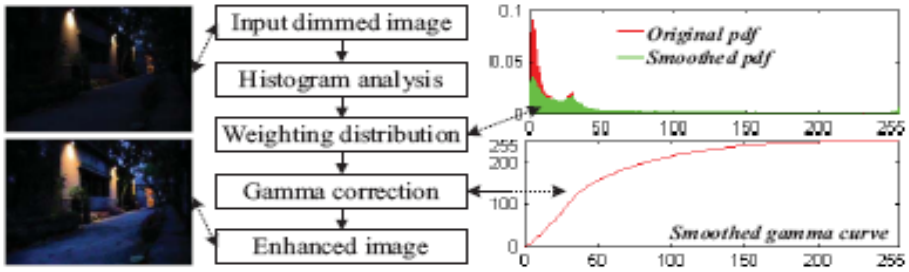

Figure3.1 Flowchart of AGCWD method

This AGC method can progressively increase the less intensity to avoid the decrement of high intensity.More so, the weight distribution function has applied slightly to change statistical histogram and creates adverse effects. The WD function has displayed as:

$$pdf_w(l) = pdf_{max}\ (pdf(l) - pdf_{min} / pdf_{max} - pdf_{min}) - \alpha$$

Where α is adjusting parameter where pd fmax is maximum pd f of the statistical histogram, and pd fmin is a minimum pd f . Based on the modified cd f is estimated by

$$cdf_w(l) = \sum_{l=0}^{l_{max}} pdf_w(l) / \sum pdf_w$$

Where, sum of pd fw calculated as follows:

$$\sum pdf_w = \sum_{l=0}^{l_{max}} pdf_w(l).$$

At the last, the gamma parameter based on the cd f of the modified Equation as follows:

$$\gamma = 1 - cdf_w(l)$$

Apart from that, we have slightly modified the exisiting algorithm by using a scaling factor β. Therefore the resultant intensity value will now become:

$$T(l) = \beta\, l_{max}(l / l_{max})^{1-cdf(l)}$$

3.2 Morphological Operations:

The basic operations in morphology are:

1). Erosion

The normal impact of operator on the binary image is to erode away boundaries of the regions of foreground pixels. Therefore areas of the foreground pixels shrink in size, and the holes inside those areas have become higher.

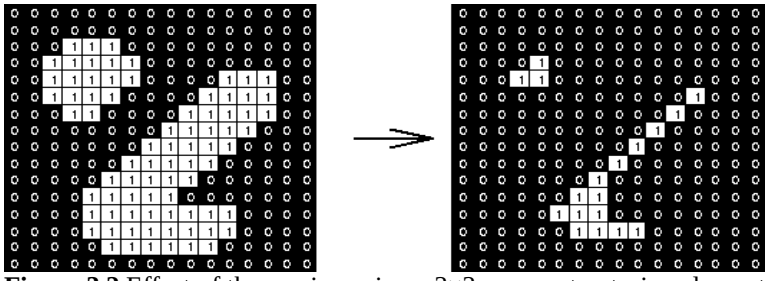

Figure 3.2 Effect of the erosion using a 3×3 square structuring element

The erosion operator takes 2 items of information as inputs. The primary is that the image that is to be scoured. The second could be a set of coordinate points referred to as a structuring part. It is the structuring part that determines the precise impact of erosion on input image.

The mathematical description of abrasion for binary pictures is as follows:

- Suppose that X is that the set of euclidian coordinates equivalent to the input binary image, which K is that the set of coordinates for the structuring part.
- Let Kx denote the interpretation of K so its origin is the x.
- Then erosion of X by K is solely the set of all points x such Kx could be a set of X.

Figure 3.3: a) Original binary image **b)** Eroded image

This image is that the results of geological process fourfold with a disk formed structuring component eleven pixels in diameter. It shows that the opening within the middle of the image will increase in size because the border shrinks. Note that the form of region has quite well to be preserved attributable to the utilization of a disk formed structuring component. In general, erosion employing a disk formed structuring component can tend to spherical saclike boundaries however can preserve the form of plano convex boundaries.

2) Dilation:

The basic result of operator on the binary image is to step by step increase the boundaries of the regions of foreground pixels. So areas of foreground pixels grow in size whereas holes at intervals those regions become smaller.

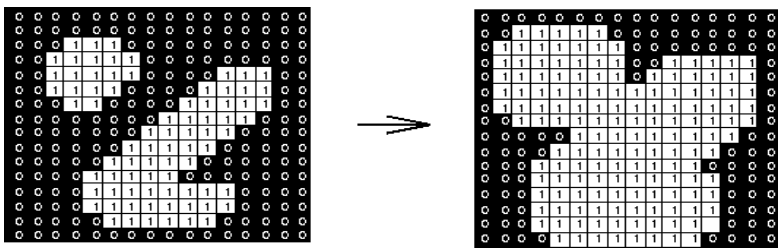

Figure 3.4: a) Original image b) Dilated image

- The dilation operator takes 2 items of information as inputs. the primary is that the image that is to be expanded. The second could be a (usually small) set of coordinate points called a structuring part (also called a kernel). It's this structuring part that determines the precise impact of dilation on input image.
- The mathematical description of the dilation for binary pictures is as follows:
- Suppose that X is that the set of geometrician coordinates equivalent to the input binary image, which K is that the set of coordinates for the structuring part.
- Let Kx denote the interpretation of K in order that its origin is called x.
- Then dilation of the X by K is solely the set of all points x such intersection of the Kx with X is a non-empty set.

Figure 3.5: Dilation

3) The same morphological operations can be used to count regions (or granules in morphological terms). For example, how many dark cells are there in the image? Using morphological operations in just a way of the region or granule counting.
4) Morphological operations can be used to estimate sizes of regions (or granules). This is clearly essential as a tool for the image processor. Two area-calculating operations are described in this chapter.
5) Image-pre-processing (noise filtering, shape simplification): Before going to morphological operations, we see some basic concepts of logical operations on binary images and some basic concepts from the set theory.

IV. Results

The results for the proposed method are shown below in Figure 5, 6, 7 and 8. Figure 9 shows the results for detection without AGCWD.

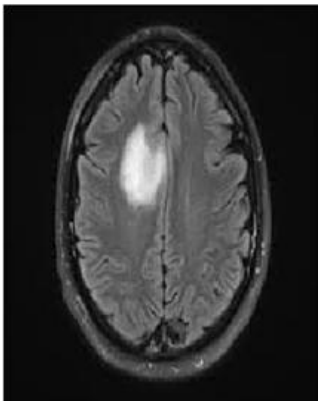

Figure 4.1: Original image

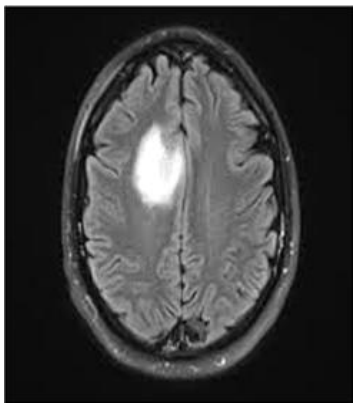

Figure 4.2: AGCWD enhanced image.

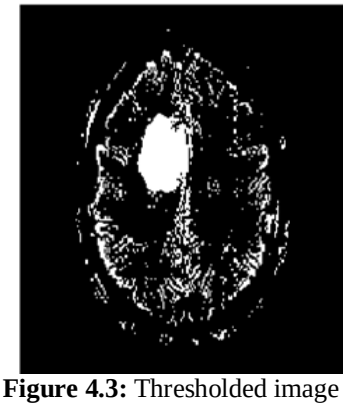

Figure 4.3: Thresholded image

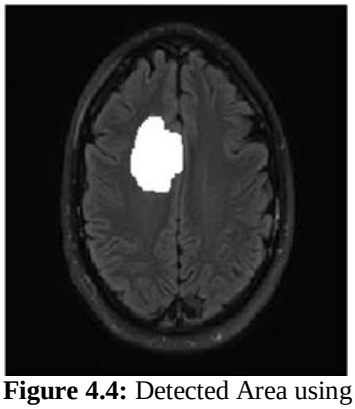

Figure 4.4: Detected Area using AGCWD

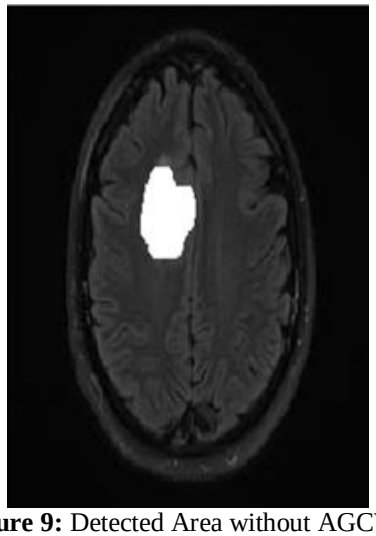

Figure 9: Detected Area without AGCWD

The results show that use of AGCWD enhances the image so that the detected area is more close to the actual defected area. Table 1 shows the area of the detected region, time for conventional method as well as the proposed method.

Table 1

	Area	**Time**
Without AGCWD	851	1.78
With AGCWD	972	1.87

V. Conclusion

The results show that the proposed technique is more practical with slight increase within the computation time. The computation time is relative to software package use however the distinction signifies that the tactic is healthier thus because the space of the detected region. The longer term prospect is to make system victimization the projected technique so as to implement a true time system for neoplasm detection. The tactic is associate degree approach for the important time detection so computationally costly improvement strategies haven't been used. The projected technique has evidenced to be higher than the present typical technique.

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