

REVIEW PAPER: MEDICAL IMAGE PROCESSING IN MATLAB

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Abstract— This paper is about a review of image processing algorithms that have been developed for detection of masses and segmentation techniques. Engineers have been actively developing tools to detect tumors and to process medical images. Medical image segmentation is a powerful tool that is often used to detect tumors. Many scientists and researchers are working to develop and add more features to this tool. This project is about detecting Brain tumors from Medical images using an interface Matlab. Brain tumor is introduced as life-threatening diseases and hence its need to detect this diseases fast and accurate. This can be worked out by the execution of automated tumor detection techniques on medical images. MRI is the most advisable one since it does not use ionizing radiation and it also provides greater contrast between different soft tissues of the human body. Brain tumors can be detected manually by experts from the MRI images. Pre-processing is necessary to enhance the input MRI image. Many automated techniques which use image segmentation. There are two images segmentation methods. image enhancement and noise reduction techniques are used to enhance the image quality, after that some morphological operations are applied to detect the tumor in the image. Region growing is the segmentation based on similarity criterion and edge detection is the segmentation based on discontinuity. Modified texture based region growing performs region growing by taking both the intensity and texture constrain into account. Considering the advantages of the techniques, we can determine the exact size and location of tumor.

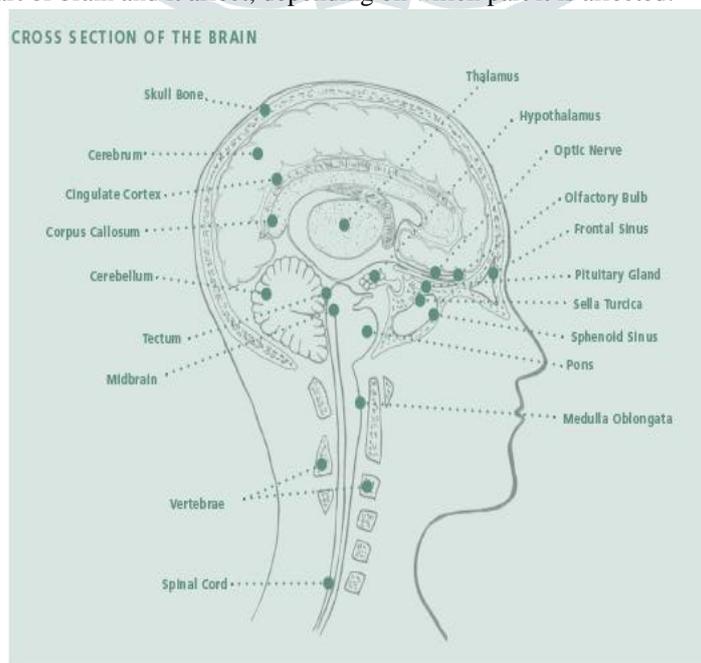
Keywords: MRI of Brain Scans, Segmentation, Brain Tumor, MATLAB, editor, image processing, Tumors, Medical image.

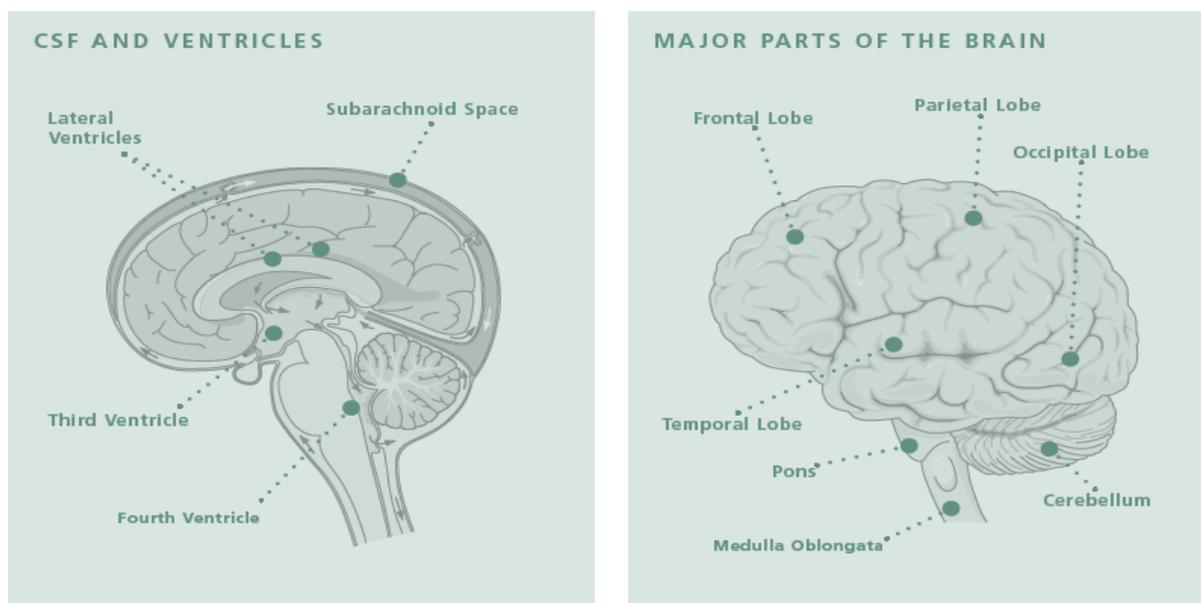
I. INTRODUCTION

Image processing has moved into the mainstream wave, not only in the engineering world; but also to the public. Personal computers now are able to handle large amount of graphics and images with ease. The fast network system and modem transfer rate are able to transfer images just in a fraction of time. Image manipulation software becomes a general and common item on personal computers. For example, Image Processing Toolbox in MATLAB provides a comprehensive set of reference-standard algorithms and graphical tools for image processing, analysis, visualization, and algorithm development. User can perform image enhancement, image deblurring, feature detection, noise reduction, image segmentation, geometric transformations, and image registration without serious difficulties.

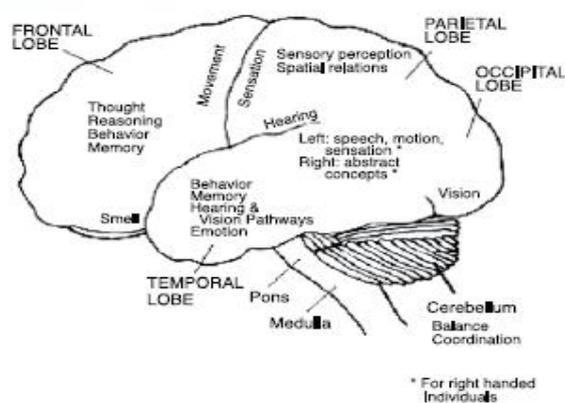
Brain tumor segmentation is a recent research in field of biomedical application. Image segmentation is the process of partitioning an image into different clusters. The goal of image segmentation is a domain independent decomposition of an image into distinct regions such as color, intensity, brightness, textures etc. An important step in segmentation is to extract the region of area in which we are interested in.

Brain tumor is unwanted growth of diseased/abnormal cell in brain in uncoordinated fashion. Brain Tumor rises the intracranial pressure within the skull which affect the region of white matter (WM), Gray matter (GM), Cerebrospinal fluid(CSF). Brain is the CPU of world's most complicated bio-computing machinery, which act as the center of thoughts, emotions, wisdom, communication, coordination of muscular movements from sense organ(pain, taste, sight, hear, touch) etc. The brain tumor having various symptoms like tumor size, type and location. Tumor can affect any part of brain and it affect, depending on which part it is affected.





WHERE IS MY TUMOR?



LOBES OF THE BRAIN

Brain tumor is of two types either it is Benign or it is Malignant Tumor.

- **Benign Tumor:**

Benign tumors are non-cancerous cells, which do not invade in surrounding healthy tissue. The growth is very slowly and the periphery or edge of benign tumor can be clearly visualized. Benign brain tumor are sometimes life threatening when it press the sensitive region of brain.

- **Malignant Tumor:**

Malignant tumors are cancerous cells, which do invade in surrounding healthy tissue and spread to other part of brain or spine. In this tumor grows very faster and more fatal than benign tumor. The edge do not clearly visualized due to penetration in nearby cells.

- **TUMOR EFFECTS**

With a limited amount of space in the skull, the growth of anything that doesn't belong there can change the way the brain works. These changes may be temporary or permanent.

Tumors can cause direct damage to brain tissue, a shifting of the brain as the tumor grows or pressure on the brain. As a tumor grows, the symptoms often correspond to the affected parts of the brain. Therefore, it's important to ask the doctor where the tumor is located.

The most common tumor locations and the related effects, are as follows:

Frontal Tumors cause a lack of interest in an individual's surroundings, as well as mood swings and changes in ethical standards. Problem solving may become difficult because of a lack of concentration. Behavior and personality changes also may occur and short-term memory (memory of recent events) may diminish. When the memory cannot "remember" words, it may be difficult to express thoughts in words or writing. The frontal lobe also plans and begins the sequences of movement.

Parietal Tumors can cause a decreased awareness of sensation against the body. Difficulty recognizing body position or body parts may be noticed. If the tumor is in the dominant (usually left) hemisphere, confusion of the left and right sides of the body may occur. The parietal lobe also controls language and arithmetic ability. Numbers can be read, but the loss of recognition of left-right or up-down positioning can make it difficult to add, multiply or comprehend material presented in side-by-side columns. Similarly, sentences that contain a comparison or a cross-reference may not be understood.

Temporal Tumors are frequently "silent" unless they reach a significant size. They can cause a dreamy "deja vu" state. Sense of time may be disturbed. The temporal lobe also controls the ability to hear and understand what is heard. Sounds or the source of the sound, may not be recognized. Music and voices may be hallucinated or sounds may be heard louder or softer than they actually are. Behavior changes may occur. There also may be difficulty in remembering recent events.

Occipital Tumors disturb vision and the ability to recognize what is seen. The occipital lobe contains complicated visual connections, thus a tumor in this area can cause various forms of visual loss. Double vision, loss of half of the vision in one or both eyes or blindness in only one direction may occur. Visual hallucinations may cause a temporary "dreamy" state. Facial expressions may not seem familiar.

Optic Nerve Tumors can reduce visual accuracy. The location of the tumor along the nerve determines what part of the visual field is lost. A tumor of the optic chiasm (where the optic nerves cross) can cause vision loss in both eyes. Headaches and nausea may be caused by pressure on the surrounding brain tissue.

Cerebellar-Pontine Angle Tumors (such as acoustic neuromas) cause pressure on the seventh and eighth cranial nerves. Ringing in the ears or a one-sided hearing loss (often first noticed when using the telephone) may occur. Dizziness and one-sided facial weakness are common.

Brain Stem Tumors often cause vomiting and a clumsy gait. The tumor can affect tongue movements, making swallowing and speaking difficult. One-sided hearing loss may occur. Unusual eye movements can cause dizziness or unsteadiness in walking. The brain stem also controls vital life functions such as breathing and heartbeat.

Hypothalamic and Pituitary Tumors can disturb appetite and the desire for food. The pituitary gland also controls the normal production of hormones in the body. A tumor in this area may change the amount of hormones made by the pituitary gland. Hormone disturbances can cause water balance problems, abnormal growth, sleep disturbances and emotional changes. Sexual development may be delayed or advanced or sexual desire may change.

Thalamic Tumors may cause sensory changes on one side of the body. Tremors during purposeful movement may be noticed.

Posterior Fossa Tumors (such as choroid plexus, fourth ventricle and cerebellar tumors) may cause tremors or a clumsy, uncoordinated pattern when walking. Nerve irritation may cause pain in the base of the head.

➤ **Diagnosis**

MAKING A DIAGNOSIS

Your doctor begins the diagnosis by taking your medical history and asking you to describe your symptoms, including how long you have had them, when they occur, the order of their appearance, if they seem to be brought on by something in particular and if they seem to be getting worse. Then your doctor will perform a basic neurological examination in the office.

NEUROLOGICALEXAM

A basic neurological examination includes the following tests:

- Eye movement by following a moving finger; pupil reaction and eye reflex using a pen light
 - Vision, including an examination of the optic nerve
 - Hearing using a ticking watch or tuning fork
 - Reflex using a rubber hammer
 - Balance and coordination – heel-to-toe walking, heel-to-shin movements; balance with feet together and eyes closed; rapid alternating movements such as touching the finger to the nose with eyes closed
 - Sense of touch using a sharp object and a cotton ball or paint brush
 - Sense of smell with various odors
 - Facial muscle including smiling and grimacing
 - Tongue movement and gag reflex
 - Head movement
 - Mental status, such as stating the current time and date, naming the current president
 - Abstract thinking, such as defining the meaning of a stitch in time saves nine
 - Memory tests, such as repeating a list of objects, describing the food you ate at yesterday's breakfast, what occurred last month
- If the results of your neurological examination lead the doctor to suspect you have a brain tumor, a scan will be ordered or you might be referred to a neurological specialist for additional testing including scans, X-rays or laboratory tests.

➤ **IMAGING**

Imaging takes the place of conventional X-rays, which do not show tumors located behind the hard bones of the skull or spine. The most commonly used imaging methods for diagnosis and follow-up are Computerized Tomography (CT) and Magnetic Resonance Imaging (MRI).

Both CTs and MRIs use computer graphics to create an image of the brain. During a scan, an injection of a special contrast material (dye) is given to make abnormal tissue more obvious. Contrast materials are able to highlight abnormalities such as tumors because the dye concentrates in diseased tissues due to the leakiness of blood vessels in and around brain tumors.

➤ **CT Scan**

This scan combines an X-ray device with a computer. For some types of tumors, CT images are obtained both with and without contrast enhancement to provide important additional information.

If contrast is used, it is usually injected after a few pictures are taken. The patient lies on a table that slides into a doughnut-shaped opening. The CT scanner circles the head so the X-rays penetrate the brain from many directions. Absorption of the X-rays varies with the type of tissue being scanned. Thousands of thin cross-section readings are fed into the computer, which transforms the information into a picture. The CT scan is probably the most routinely used imaging technique for diagnosis and follow-up of many tissue abnormalities. Recent studies on the radiation exposure caused during CT scans are helping doctors to redefine when a CT scan versus another type of scan is most appropriate.

➤ **MRI Scan**

The MRI is a tunnel-shaped piece of equipment. Some pictures are taken before the contrast injection. If contrast is used, it will be injected prior to the completion of the scan. The patient lies on a table that slides into the tunnel. Inside the scanner, a magnetic field surrounds the head and a radio frequency pulse is introduced to the area. No X-rays are used. The magnetic field causes atoms in the brain to change direction. The radio frequency pulse causes another change of direction. When the pulse stops, the atoms relax and return to their original position. During relaxation, the atoms give off energy in differing amounts and at different intervals of time. Antennas pick up these signals and feed them into a computer, which assembles a picture. Because different atoms have their own characteristic radio signals, the computer can distinguish between healthy and diseased tissue.

Patients with some cardiac monitors, pacemakers or some types of surgical clips cannot undergo MRI scanning because of the magnetic fields. For those who are claustrophobic, sedation or open MRI scanners may be an option.

There are several different types of MRIs now available. Some of these are commonly used (such as fast MRI) while others are still being developed (such as diffusion tensor imaging).

An MRI offers images with excellent anatomical detail that provides clarity of the small structures in the brain, but the images often lack quantitative or finely measurable, information. Because of this lack of very fine measurable detail, it can take a while before the effectiveness of drug therapies can be imaged. Researchers are working toward new scanning techniques that will more rapidly image treatment effects.



II. LITERATURE REVIEW

The rapid development of information technology has directly impacted on the techniques in image processing techniques and the implementation of survey processing systems. This main development has been shifted from mainframe system to PC platform. User now can easily perform all kind operations and processing techniques ranging from small scale to large scale statistical operations.

The research framework and methodology complies with ADDIE model. ADDIE model is the generic process traditionally used by instructional designers and training developers. The five phases including Analysis, Design, Development, Implementation, and Evaluation represent a dynamic, flexible guideline for building effective training and performance support tools. Our work starts with conducting a survey to the new learners/students about their understanding on Biomedical Image Processing course to identify any problems or issues of how difficult to them to understand the Biomedical Image Processing course. To make meaningful to these new learners, we are going to develop user friendly Biomedical Image Processing software package, which new learners can do some Biomedical Image Processing analysis through various methods that have been taught in Biomedical Image Processing course.

Our plan is to use the MATLAB programming software as a tool for developing this Biomedical Image Processing software package. Such techniques (image enhancement, filtering, segmentation and morphological operation) in Biomedical Image Processing that have been taught in the class (or in the syllabus) will be included in the Biomedical Image Processing software package. This software package should capable to display input image, output image and various click button for various image processing techniques as well as description of the techniques so the students will learn effectively the application on how biomedical image is analyzed instead of learning the mathematical algorithm for such techniques.

A number of software packages for the image processing and editing have increased over the years. The different steps of image processing make each of the software packages differ with different relative strengths. Having the right software and appropriate processing techniques is necessary to guarantee the reliability of the data processing.

The famous well-developed software packages for image processing are as follow:

- **Adobe Photoshop**

Adobe Photoshop is a graphics editing program and used in teaching and research. It was generally found to be useful and easy to use. It comes with functionality for scanning and scanned image manipulation. It can produce simple integration with other Adobe products.

- **Adobe Illustrator**

It is the industrial standard software and works well with other graphics software. Not easily compatible with WORD and Windows PC users cannot easily send images to a non graphics PC user.

- **ImageTool**

ImageTool is a free package with powerful image processing capabilities. The main function is an image analysis and it is quite easy to use. According to the developer, ImageTool has no guaranteed future development and has no direct support.

- **LabView**

Its main use is to convert from one image file format to another. A large number of image formats are supported. Images can be increased or reduced in size. Image resolution may be altered in the preparation of images for importation into word-processing or desktop publishing packages.

- **Paint Shop Pro**

It is used both in teaching and research. It is regarded as easy to use and useful. It is robust, good documentation and capable in conversion between different image file formats.

- **ImageJ**

ImageJ is a freeware. It is a free package with powerful image processing capabilities. The most used features of the software are image editing, processing, and enhancement.

- **Image Prep**

Image Prep is a specialist graphics manipulation package which has proved to be very useful for converting and enhancing graphics images. Used for manipulation of scanned photographic images for research software generation.

➤ ERDAS Imaging

It is a package designed to plan for surface change such as urban development, transport planning and landscape planning. It is very useful but fairly difficult to use. Very hard to start off with, but once you have conquered the initial problems it becomes a lot easier.

➤ MATLAB

MATLAB is a high-level technical computing language and interactive environment for algorithm development, data visualization, data analysis, and numerical computational. It is easy on customization and able to handle large matrices. It also uses the language script to customize statistical tests and matrix manipulation.

➤ Microsoft Photo Editor

A fairly easy and useful drawing package for drawing graphs within WORD documents used in preparation of teaching materials. Straight forward intuitive mouse-driven actions and the ease with which images could be embedded within WORD documents.

III. PROBLEM FORMULATION

Imaging has become an essential component in medical research and clinical practice. A wide variety of image processing techniques have been used in medical field for image analysis. This employs a large number of visual and physiological features, a fact which usually impedes the training process.

Brain tumor detection is a serious issue in imaging science. Generally, the severity of disease decide by size and type of tumor. An important step in analysis of brain MRI scan image is to extract the boundary and region of tumor. To solve the problem, the proposed work describes the strategy for detection, segmentation and feature extraction of brain tumor part inexpensive format using MATLAB software. This software based approach aims to introduce an algorithm for detecting and segmenting the brain tumor from normal brain using basic image processing operations, segmentation, feature extraction in MATLAB.

This survey focused on identifying specific software packages; and its advantages and disadvantages of using it. On the other hand, this survey also tries to communicate with software vendors in discussing on how technological problems can be resolved. The survey is very important in order to develop the software tools to give new learners the ability to analyze biomedical data to support the discovery and advancement of biomedical knowledge.

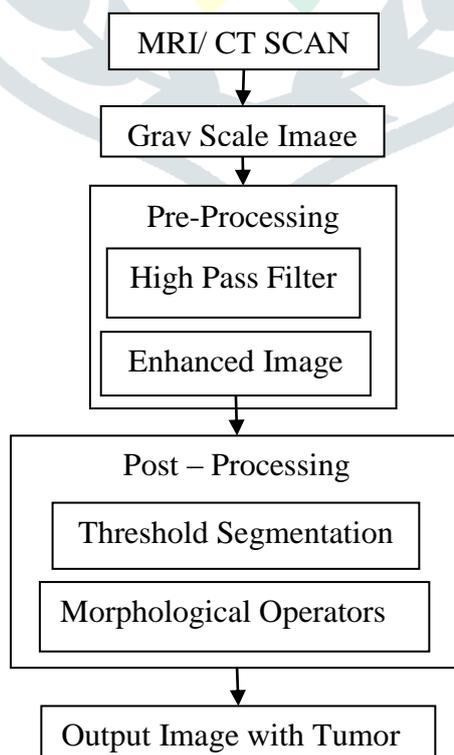
In this study, the practice item of image processing software package was focused on Matlab application. Several imperatives were identified to be addressed by the survey:

- 1) To discover the current visualization practice in Image Processing Tools Package in Medical Imaging in MATLAB biomedical image processing techniques.
- 2) To relay current general and subject specific technological limitations. In this paper, an effective medical image processing for image processing is presented through survey result. Several aspects like the speed of the processing and ease of use are considered while the processing is being done. This is to make sure the software package does not only process the raw image for further analysis, but it is also able to manage the image data effectively and provides accurate and reliable scientific information.

IV. PROPOSED METHODOLOGY

The proposed algorithm starts by reading the input brain MR/CT image and converting it into grey scale image. There are three major steps in the proposed approach. The first step is image pre-processing, the second step is post-processing. Fig. 1 shows the steps included in proposed system for brain tumour detection using threshold & watershed segmentation.

The part of the image containing the tumor normally has more intensity then the other portion and we can assume the area, shape and radius of the tumor in the image. We have used these basic conditions to detect tumor in our code and the code goes through the following steps:



V. CONCLUSION

Brain tumor is one of the mainly life-threatening diseases and hence its detection should be fast and accurate. MRI images are very important for detecting the existence and outlines of tumors. Pre-processing is necessary to enhance the input MRI image. The work of physician makes easier by enhancement of images which gives quick judgment of images. For detecting the survival and outlines of tumors from the brain tissue in the magnetic resonance imaging (MRI) is very important, therefore combination of both modified texture based region growing and segmentation is used for detection of brain tumor.

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