Detection of Brain Abnormality for Alzheimer’s Disease Using Image Processing Techniques

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Abstract: Digital Medical imaging is the technique and process of creating visual representations of the interior of a body for clinical analysis and medical intervention. This is highly expensive and complex due to the requirement of proprietary software and expert personnel. Here we introduce a software called MATLAB which is user friendly general and visualization program for detection of brain disorders called Alzheimer’s disease in early stage. This application will provide the result of clinical analysis of digital medical images i.e. Magnetization Resonance Image scans of a brain. The minute structural difference of brain may slowly results in major disorder of brain which may cause gradually Alzheimer’s disease. In this paper the primary focus is on bi-cubic interpolation technique which is used for detection & diagnosis of Alzheimer’s disease.

Keywords– bi-cubic interpolation Alzheimer disease, Magnetization Resonance image, MATLAB etc.,

I. INTRODUCTION

The brain is the most complex organ in the human body. The abnormal behavior of brain may lead to the effect of total collapse of entire body functionalities. Such brain abnormality may result in Alzheimer’s disease. In this paper we introduces a user friendly GUI application based for detection of Alzheimer’s Disease. For this MRI scanned images of brain is taken as input data and morphological operations are applied to detect abnormalities for the diagnosis.

II. ALZHEIMER’S DISEASE

Alzheimer’s is a progressive disease, where dementia symptoms gradually worsen over a number of years. In its early stages, memory loss is mild, but with late-stage Alzheimer’s, individuals lose the ability to carry on a conversation and respond to their environment. Alzheimer’s is the sixth leading cause of death in the United States. Those with Alzheimer’s live an average of eight years after their symptoms become noticeable to others, but survival can range from four to 20 years, depending on age and other health conditions. Alzheimer’s has no current cure, but treatments for symptoms are available and research continues. Although current Alzheimer’s treatments cannot stop Alzheimer’s from progressing, they can temporarily slow the worsening of dementia symptoms and improve quality of life for those with Alzheimer’s and their caregivers. Today, there is a worldwide effort under way to find better ways to treat the disease, delay its onset, and prevent it from developing.

In Alzheimer’s the total brain size shrinks, and the tissue has progressed is very few nerve cells and connections. In general just like our body structure the size of brain is also changes as we get older. As a result this is cause to in lower thinking & occasional problems of remembering certain things. The Alzheimer’s Association says in its early onset information that doctors do not expect to find Alzheimer’s disease in younger people. For the younger age groups, doctors will look for other dementia causes first.

Visualization of brain structure and function from the level of individual molecules to the whole brain. Many imaging methods are noninvasive and allow dynamic processes to be monitored over time. Imaging is enabling researchers to identify neural networks involved in cognitive processes; understand disease pathways; recognize and diagnose diseases early, when they are most effectively treated; and determine how therapies work.

Moreover, as in other areas of biomedical research, these opportunities are interactive. As an example, imaging can provide a better understanding about a disease process that leads to discovery of potential therapies that intervene in that process. Thereafter, imaging can help provide a better understanding about how that drug or therapy works at the molecular level, leading to a more precise understanding of the disease process and then to development of a more highly specific drug to treat it.

Different types of imaging are used to reveal brain structure (anatomy), physiology (functions), and biochemical actions of individual cells and of the molecules that compose them, and of cells’ functions, behaviors and interactions. The three main categories, therefore, are often referred to as structural, functional and molecular imaging. While many imaging techniques
are used throughout the body, the descriptions provided here focus on their use in the nervous system, primarily the brain.

A) Imaging’s Evolution: Early Structural Imaging Techniques

While many structural and functional imaging techniques are relatively recent, the origin of structural imaging was the X-ray, developed in 1895. This technology was the clinician’s main imaging tool for more than half of the 20th century. For brain imaging, numerous X-ray beams are passed through the head at different angles. Special sensors measure the amount of radiation that is absorbed by different tissues. Then, a computer uses the differences in X-ray absorption to form cross-sectional images or “slices” of brain called “tomograms.”

<table>
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<tr>
<th>State</th>
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Even it cannot be seen or tested in the living brain of Alzheimer’s disease affected people, but postmortem/autopsy will show the tiny inclusions in the nerve tissue, called as plaques and tangles. The Plaques are detected between the dying cells in the brain — beta-amyloid and tangles are detected within the brain neurons — from tau.

**Figure:** Shows the number of people having Alzheimer’s disease.

### III. BRAIN IMAGING TECHNOLOGY

Imaging is becoming an increasingly important tool in both research and clinical care. A range of imaging technologies now provide unprecedented sensitivity to

B) Computed Tomography

CT imaging was the first technique, for instance, to show clear evidence, during life, of decreases in the amount of brain tissue in older compared to younger people. CT can be used with or without contrast agents...
(dyes, such as iodine, that make structures easier to see), but use of contrast enables CT to show bone, soft tissues and blood vessels in the same images. Because CT can be done quickly, it is especially useful in emergency trauma situations, showing any abnormalities in brain structure including brain swelling, or bleeding arising from ruptured aneurysms, hemorrhagic stroke (a ruptured blood vessel), and head injury.

C) Magnetic Resonance Imaging

Fortuitously, abandonment of ultrasound to try to detect brain tumors came at the same time that new radiological technologies for brain imaging such as magnetic resonance imaging (MRI) were emerging. Beginning in the 1980s, however, new ultrasound techniques (“Laser Doppler Ultrasound”) began to evolve; these techniques employ laser technology to combine information from both light and sound and have become a vital part of intensive monitoring of cerebral blood flow in patients with severe head trauma. The setechnologies and their uses are described later in the section on Electrical and Doppler Ultrasonic Imaging Techniques.

C)Positron Emission Tomography

Positron Emission Tomography (PET) was the first major technology to measure physiological functioning in the brain. In PET scanning, the regional distribution of exogenously administered positron emitting tracers is measured using tomographic imaging. The first PET tracer to be used in humans was 18F-deoxyglucose, which distributes according to regional glucose utilization. Because water is freely diffusible from the blood to the brain, 15O-H2O provides a PET tracer for measuring cerebral blood flow, and was another early tracer used for measuring regional brain function.

D) Electroencephalography

EEG measures the electrical activity that is produced by neurons as recorded from electrodes placed along the scalp. MEG maps brain activity by measuring magnetic fields that are generated by neural activity in the brain. Both EEG and MEG provide information about global as well as regional neural activity, but with MEG there is less distortion of the electrical signals. Often one or the other of these electrophysiological methods is combined with fMRI or PET to provide complementary information about normal and disturbed brain function.

E) Magnetoencephalography

MEG, by measuring magnetic fields, is used to investigate the basis of sensory processing and motor planning in the brain. MEG is used with MRI in brain tumor patients prior to their surgery to identify the hemisphere controlling language and to precisely locate the areas involved in expressive and receptive language so that surgeons can spare these areas during surgery. Sometimes, patients who will be undergoing this pre-surgical planning will agree to participate during the MEG/MRI procedure in research designed to explore brain processes that may be involved in stuttering, or in memory.

F)Near Infrared Spectroscopy

Near infrared spectroscopy (NIRS) is an optical technique for measuring blood oxygenation in the brain. It works by shining light in the near infrared part of the spectrum (700-900 nm) and detecting how much the re-emerging light is attenuated and also how much the light is attenuated depends on blood oxygenation and thus NIRS can provide an indirect measure of brain activity.

IV. IMAGE REGISTRATION

Image processing methods, which are possibly able to visualize objects inside the human body, are of special interest. Advances in computer science have led to reliable and efficient image processing methods useful in medical diagnosis, treatment planning and medical research. In clinical diagnosis using medical images, integration of useful data obtained from separate images is often desired. The images need to be geometrically aligned for better observation. This procedure of mapping points from one image to corresponding points in another image is called Image Registration.

G)Image Registration Methodology

Image registration essentially consists of following steps as per Zitova and Flusser.

i. Feature detection: Salient and distinctive objects (closed-boundary regions, edges, contours, line intersections, corners, etc) in both reference and sensed images are detected.

ii. Feature matching: The correspondence between the features in the reference and sensed image established.

iii. Transform model estimation: The type and parameters of the so-called mapping functions, aligning the sensed image with the reference image, are estimated.

iv. Image resampling and transformation: The sensed image is transformed by means of the mapping functions.

Fig2.Steps involved in image Registration
V. COLOR IMAGE SEGMENTATION

In Digital imaging segmentation is the process of separating or grouping an image into different parts. These parts normally correspond to something that humans can easily separate and view as individual objects. Computers cannot have the means of intelligently recognizing objects, and so many different methods have been developed in order to segment images. The color image segmentation is also widely used in many multimedia applications, for example; in order to effectively scan large numbers of images and video data in digital libraries, they all need to be compiled directory, sorting and storage, the color and texture are two most important features of information retrieval based on its content in the images and video. Therefore, the color and texture segmentation often used for indexing and management of data; another example of multimedia applications is the dissemination of information in the network.

H) Region Based Techniques

Region based methods are generally based on continuity. These techniques are divide the entire image into sub regions depending on some rules like all the pixels in one region must have the same gray level. Region-based techniques rely on common patterns in intensity values within a cluster of neighboring pixels. The cluster is referred to as the region, and the goal of the segmentation algorithm is to group the regions according to their anatomical or functional roles.

I) Clustering Technique

This method splits the images into K groups or clusters. The mean of each cluster is taken and then each point p is added to the cluster where the difference between the point and the mean is smallest. Since clustering works on hue estimates it is usually used in dividing a scene into different objects. The performance of clustering algorithm for image segmentation is highly sensitive to features used and types of objects in the image and hence generalization of this technique is difficult. Ali, Karmarkar and Dooley[2] presented a new shape-based image segmentation algorithm called fuzzy clustering for image segmentation using generic shape information (FCGS) which integrates generic shape information into the Gustafson-Kessel (GK) clustering framework.

J) Thresholding

This is the simplest way of segmentation. Using thresholding technique regions can be classified on the basis range values, which is applied to the intensity values of the image pixels. Thresholding is computationally inexpensive and fast, it is the oldest segmentation method and is still widely used in simple applications. Using range values or threshold values, pixels are classified using either of the thresholding techniques like global and local thresholding. Global thresholding method selects only one threshold value for the entire image. Local thresholding selects different threshold values for different regions. To segment complex images multilevel thresholding is required.

K) Edge Based Techniques

Segmentation Methods based on Discontinuity find for abrupt changes in the intensity value. These methods are called as Edge or Boundary based methods. Detection techniques are generally used for finding discontinuities in gray level images. Edge detection is the most common approach for detecting meaningful discontinuities in the gray level. Image segmentation methods for detecting discontinuities are boundary based methods. Edge detection can be done using either of the following methods: Edges are local changes in the image intensity. Edge detection is an important task for image analysis. These features are used by higher-level computer vision algorithms (e.g., recognition). Edge detection is used for object detection which serves various applications like medical image processing, biometrics etc. Edge detection is an active area of research as it facilitates higher level image analysis. There are three different types of discontinuities in the gray level like point, line and edges. Spatial masks can be used to detect all the three types of discontinuities in an image.

VI. SYSTEM DESIGN

The issue in analysis of images include, 3D reconstruction, shape analysis, transport of data, identification of boundary, volume estimation, image overlay, etc. This requires that investigators must have access to suitable methods for bio medical image analysis. Different minimization method, cost function, different sampling, editing & smoothing strategies are compared. Internal consistency measurements were used to place limits on registration accuracy for MRIs can. All strategies were cons is tent  to s t function, different sampling, editing & smoothing strategies are compared. Internal consistency measurements were used to place limits on registration accuracy for MRIs can. All strategies were cons is tent  to s t function, different sampling, editing & smoothing strategies are compared.

The Estimated accuracy of registration of structured MRIs can images was in 75.5 um to 149.5 um range. The main emphasis is given to the color combination of s o me brain tissues. The spaces in the sulci can be easily detected by their color combination.

Fig3: shows cerebral cortex region with and without color strain.

VII. FOR MULATION OF MODEL

The following steps are used to implement bi-cubic interpolation of an image

➢ As a first step take input of the image using Bi-cubic interpolation.
All Exception has to be Manage while loading the zoomed image.
Obtain the pixel map.
Now extract the cavity area of sulci.
Calculate the sum of all pixel values of 3 arrays (red, green, blue) from c rapped area.
If values are found 0 recognize as black.
Create a cavity array by placing all identified pixel (that is b lack).
Else put all non-black pixels into an array called core x_arr pared
Calculate he length of cavity & cortex array by using length function.
If (length of cavity array is more), then trace as abnormality.
Else it’s normal in nature.

Fig 3. Abnormal area & Measurement of abnormality

VIII CONCLUSI0N

Due to heavy cost much of the medical imaging software tools are far from the reach of common man. In this paper, an attempt is made to develop a simple software tool using MATLAB to detect the structured abnormality of the brain tissues. The task has almost being fulfilled & provides a better enhancement of images which is achieved by implementing bicubic interpolation in place of bilinear interpolation to get a better res ult. But it s till requires more perfection. The highlight of this software tool is its simplicity coupled with user friendliness & keen observation of medical image at minute levels.

REFERENCES