ISSN: 2278 – 7798
International Journal of Science, Engineering and Technology Research (IJSETR)
Volume 2, Issue 10, October 2013

Soft sensor based brain tumor detection using CT-MRI

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***Abstract*---- Brain tumor diagnosis is a very crucial task. It is a life threatening disease which has been a challenging phenomenon for both medical and engineering technologists. The two imaging modalities namely CT and MRI has been a tremendous and most valuable diagnostic tool in the detection of brain tumor because of its efficient and objective evaluation of large amounts of data. In this paper image processing techniques and morphological operations are performed on CT and MRI images and tumor area is calculated and a comparison output of both the image set are produced.**

***Index terms*---- CT (Computed Tomography), Morphological operations, MRI (Magnetic Resonance Imaging), Brain Tumor.**

I. INTRODUCTION

Human brain is surrounded by a system of connective tissue membranes called meninges that separate the skull from the brain. The brain is an incredibly complex organ made of soft spongy mass of tissue. The function of the brain is to exert centralized control over the other organs of the body. The brain acts on the rest of the body both by generating patterns of muscle activity and by driving the secretion of chemicals called hormones. This centralized control allows rapid and coordinated responses to changes in the environment. Some basic types of responsiveness such as reflexes can be mediated by the spinal cord or peripheral ganglia, but sophisticated purposeful control of behavior based on complex sensory input requires the information integrating capabilities of a centralized brain.

Manuscript received Sep 2013;

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The human cerebral cortex is a thick layer of neural tissue that covers most of the brain. This layer is folded in a way that increases the amount of surface that can fit into the volume available. The pattern of folds is similar across individuals, although there are many small variations. The cortex is divided into four lobes, called the frontal lobe, parietal lobe, temporal lobe and occipital lobe. Within each lobe are numerous cortical areas, each associated with a particular function such as vision, motor control, language, etc. There are other functions, such as spatiotemporal reasoning, for which the right hemisphere is usually dominant. Brain tumors are abnormal and uncontrolled proliferations of cells. Detection of brain tumor is a serious issue in medical science. Access to these tumors is difficult and MRI and CT scan could be helpful in determining anatomical location of tumors and distinction of malignant from benign.

1.Tumor:

The word tumor is a synonym for the word neoplasm which is formed by an abnormal growth of cells reproducing themselves in an uncontrolled manner. Any brain tumor is inherently serious and life threatening because of its invasive and infilterate character in the limited space of the intracranial cavity. Brain tumor is one of the major causes for the increase in death among children and adults. There are two main types (i) Beningn (non-cancerous) tumors are not capable of spreading beyond the brain and their growth is self limited. (ii) Mallignant (cancer), tumors can spread outside the brain and are more harmful and should be treated. Both type of tumors are potentially diabling and life threatening.

2.CT and MRI:

Computed Tomography uses rotating X-rays to generate images of the body, including bone. CT

uses ionizing radiation to image the body, while MRI uses strong magnetic field to align the nuclear magnetization, then radio frequencies changes the alignment of the magnetization which can be detected by the scannar. The MRI unit looks similar to CT unit. For both the imaging techniques the patient is placed on the table that slide through the middle of the machine to obtain images of specific anatomy. The difference is that in CT tube (where the patient is placed) is much shorter and the scans take much less time than in MRI. CT images have been widely utilized in producing high quality medical images. Both the methods have become a vital part of research as it has complex problems for the proper diagonosis of brain tumors.

Various types of brain tumor and their diagnostic methods are provided in engineering prespective[1] Survey on MRI based images provides a clear view on several imaging techniques[2]It explains in detail about the automated techniques for brain tumor detection in MR images[3] Evaluated the literature to reveal new facts, imaging modalities in brain tumor[4] It gives the overview of the role of CT and MRI in diagonosis of brain tumor, analysis of multimodal imaging data[5] It shows the combination of neuroimaging modalities, neural network based detection techniques and alsodescribes about learning vector quantization with image and data analysis and manipulation techniques are carried out[6]. The paper is organised as follows, in section II image preprocessing techniques are sumarized, the proposed approach including morphological operations and conversion techniques are also presented. Section III shows results and discussion, Section IV presents the conclusion.

II METHODOLOGY

The following sequence of operations is carried out in detecting the tumor area. Various pre processing techniques are employed (ie) each frame was converted from RGB to greyscale mode. The output image has 256 grey levels, ranging from 0 (black) to 256 (white). A greyscale version of the background image is prepared. This background image is used for image contrast enhancements. Conversion of a greyscale image to binary mode results in a reduction in number of grey levels to two levels of the original image: one corresponding to black (0) and another corresponding to white (1). This is accomplished by means of a threshold value, i.e., a pixel value (or luminosity) defining the transition between black and white colours. From the enhanced image morphological operations are performed and the tumor area is detected.

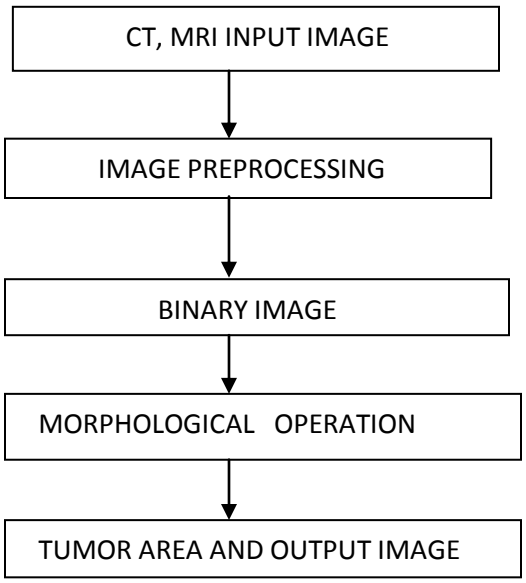

Fig. 1 Sequence of operations

a. Image preprocessing

Before detecting the tumor in the image it should undergo preprocessing. Image pre-processing can significantly increase the reliability of an optical inspection. Initially the datas are acquired and they are pre-processed in order to extract the necessary information. During the process of image formation, the quality of images may degrade due to variety of causes such as out of focus, distortion of optical systems, the relative motion between the camera and the scene etc. Essentially it tries to perform an operation on the image that is the inverse of the imperfections in the image formation system.

b. Image enhancement:

The aim of image enhancement is to improve the interpretability or perception of information in images for human viewers, or to provide better input for other automated image processing technique. Spatial domain methods, which operate directly on pixels and frequency domain methods, which operate on the Fourier transform of an image. When image enhancement techniques are used as pre-processing tools for other image

processing techniques, then quantitative measures can determine which techniques are most appropriate measures.

c: Binary image:

A binary image is a digital image that has only two possible values for each pixel. Typically the two colors used for a binary image are black and white though any two colors can be used. The color used for the object(s) in the image is the foreground color while the rest of the image is the background color. Binary images are also called bi-level. The names black and white also monochrome monochromatic are often used, but may also designate any images that have only one sample per pixel, such as grayscale images.

d: Morphological operators:

After converting the image in the binary format, some morphological operations are applied on the converted binary image. The purpose of the morphological operators is to separate the tumor part of the image. It is a collection of non-linear operations related to the shape or morphology of features in an image. Morphological operations rely only on the relative ordering of pixel values, not on their numerical values, and therefore are especially suited to the processing of binary images.

III RESULTS AND DISCUSSION

An input image (CT and MRI) which has brain tumor is taken here for processing. Preprocessing operation and morphological are done on the following image. Matlab software and imagej tools are used for the evaluation of results and the results are obtained.

The input image shown in Fig 2 is subjected to standard preprocessing technique like image enhancement. The result in Fig 3 shows the binary image in which the tumor part is easily visible. The result in Fig 4 shows the image after it is subjected to morphological operation. It is found that the area of tumor can be easily detected from these images which will be very helpful for the doctors to visualize the amount of tumor that spread inside the brain and for performing surgery in the detected area. The table shows the measure of area of the tumor detected inside the brain. It gives the value of area of tumor to the entire area of the image.

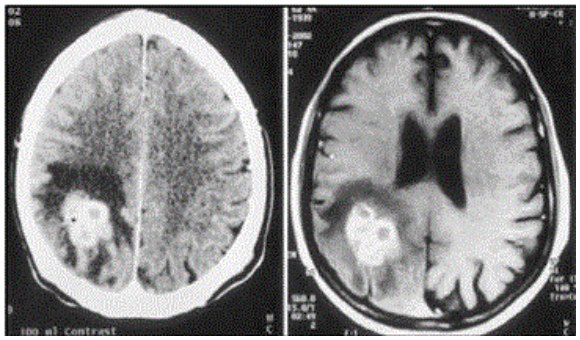

Fig.2 Input brain tumor image (a) CT image (b) MRI image

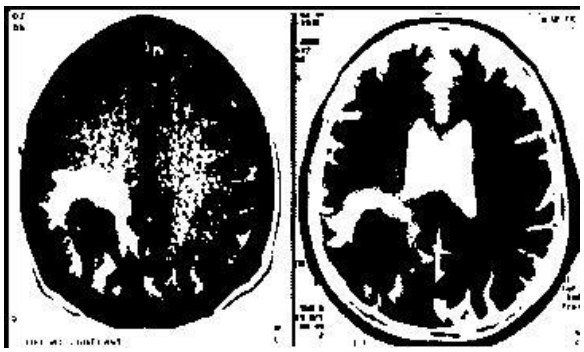

Fig. 3 Binary image

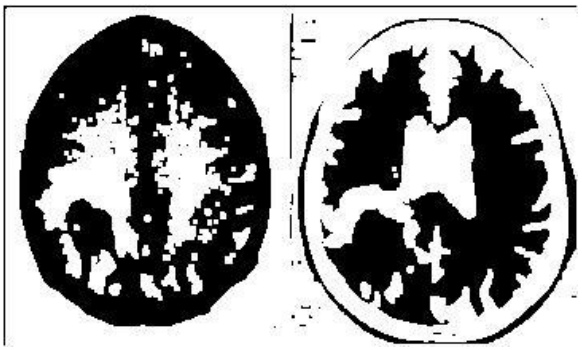

Fig. 4 Morphological images

Table: 1 Tumor area calculation

CT data	MRI data
45.32	49

IV CONCLUSION

In this proposed work a combination of different approaches has been employed such as enhancement conversion and morphological operations are performed for detecting the brain tumor. The physical dimension as well as the area is calculated from the binary image. The tumors can be found precisely according to their area and the exact position of the infected area this will be very helpful for the doctors for the analysis of the tumor and also the damage to brain. In future it is proposed to extend these methods to modern MR techniques like DTI/MRS and Perfusion imaging.

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