Brain Abnormality Detection from MR Images using Matrix Symmetry Method

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ABSTRACT
Brain abnormality is a major of cause disability and death in human being. Brain Abnormality is an abnormal growth of cells within the brain. It is the mass of tissue in which some cells grow uncontrollably. For early diagnosis of Abnormality in tissue samples research and development activities are concentrated on the exploration of automatic image analysis. Magnetic Resonance Tomography (MRT) or Magnetic Resonance (MR) imaging is one of the major techniques used by radiologist to diagnose brain internal structure. This technique uses radio frequency pulses of magnetic field to examine different organs. The output of this technique is MR image in DICOM format that can be viewed on computer. This paper reviews some remarkable works from literature along with the basic concepts related to automatic brain abnormality detection techniques. It also includes suggestions for developing a system that can locate brain abnormality in real time. In today's world many clinical centers or hospitals that maintain large database of MR images, finds the task of indexing the available database according to size or location or other attributes very difficult. To date, automated brain abnormality segmentation from MR images remains a challenging, computationally intensive task. The set of MR slices of a patient is taken as input. In this paper we consider abnormality detection problem as change detection problem, our approach is to identify the most dissimilar region between the left and right halves of brain.

Keywords
Magnetic Resonance Tomography (MRT), DICOM, Magnetic Resonance (MR) imaging

1. INTRODUCTION
Digital image process [2] found its application in medical image analysis and engineers are coming up with different techniques to help physician and surgeons in image analysis needed for diagnosis .During diagnosis usually a specific part of body is scanned and that image is then physically analyzed by surgeons.

In today's world's maintaining large database of brain Abnormality (MR) magnetic resonance images is a complicated task as the data is not indexed and cannot be searched on the basis of attributes like location or size.

1.1 MR Image
Magnetic resonance imaging technique uses radio wave pulses and magnetic field to scan organs and structure inside the body .MRI test gives various type of information required by the doctors for the treatment purpose .This technique gives every information about internal body structure that can be obtained by any other type of scans like X-ray, ultrasound etc This technique has the advantage that it provides more information compared to the other available techniques.

For an MRI test, the part of the body for which the information of its internal structure is required is placed inside the machine that has strong electromagnets to produce magnetic field. The output of MR scans is digital image in DICOM format that can be saved and stored for analysis and future reference. The MR image can be viewed and transported to places such as clinics or operating room where doctors may require it.

Fig1:-MR images machine [10]

Fig2:-open MR images machine [11]

Scanning of brain is done to obtain the internal structure of brain using computer technology. A MR scan consists of an image of internal structure of brain. Magnetic resonance imaging is a powerful tool for investigating brain for Abnormality.

The advantage of detecting brain Abnormality by MR images are: -

- There is no need to inject drug into the human body
- The entire process has not any radiation damage and is completely safe.
- Patient's body is not physically hampered for diagnosis purpose.

Using MRI scans, physicians can diagnose or monitors treatments of various types of diseases

- Abnormalities in the brain and spinal cord
- Tumors and other abnormalities in various parts of the body
- Injuries or abnormalities of the joints
- Certain heart problems
- Diseases of the liver and other organs
- Suspected uterine abnormalities in women undergoing evaluation for infertility

1.2 Risks/Benefits

MR scans produce high-energy radiation that can cause damage to DNA.

- Dyes that are inserted can be harmful and can cause damage to internal brain cells.
- Medication patches can cause a skin burn.
- The apparatus used to monitor an electrocardiogram (ECG) trace or respiration during a scan must be placed carefully to avoid causing a skin burn.

Sometimes MR images suffer from noises due to technical or human error. These errors are:-

1.2.1 Salt and Pepper Noise

It is also known as impulse noise. This type of noise occurs due to sharp and sudden disturbances in image signal at the time of acquiring the image. It appears as random white and black cells scattered all over the image.

1.2.2 Poisson Noise

Poisson noise is signal-dependent, that is often seen in photon images[6]. The variance of the noise is proportional to the original image values. The noise model is described as

$D(m, n) \sim 1/\lambda[\text{Poisson}\{o(m, n)\}]$

Where o*(m, n) and d*(m, n) mean the pixel values in the original and degraded images, respectively. The degraded image is generated by multiplying the original pixel values by λ and by using these as the input to a random number generator which Returns Poison distributed values.

1.2.3 Median Filter

Median filter is used to reduce noise in an image [2]. The best known order statics filter is the median filter, which as its name implies replace the value of a pixel by the median of the intensity levels in the neighborhood of that pixel. In a median filter the median intensity value of the pixels within the window becomes the output intensity value of the pixel being processed. Median filter preserves edges in an image while reducing random noise.

While acquiring MR images from the computer aided machines. Due to human error noise may occur which may lead to problem in Abnormality detection so it is very necessary to remove all the noise from MR images before diagnosis.

2. LITERATURE SURVEY

Some works are available in literature on automatic brain Abnormality detection technique. Some of the techniques are discussed in this section.

K Somojundran et al proposed [1] pixel to pixel approach for detecting brain Abnormality by finding the difference in intensity of pixels. In his technique, Abnormality location is detected by finding regional maxima. In these technique first MR slices containing abnormality is separated from normal MR slices, for this purpose vertical symmetry is checked. Hence fuzzy segmentation is done to discriminate between normal and abnormal slices .After segmentation, region of abnormality in MR images has increased intensity which possesses local maxima hence abnormal region is detected using extended maxima transform. His technique suffers from disadvantage and yields poor result as it is based on the contrast of MR images which can change.

Rechna Rana et al. [7] used fuzzy c-mean algorithm for detecting tumorous regain. This technique worked well only for hyper intensity (fully enhanced) Abnormality, this is due to fact that fuzzy models typically used thresholding techniques or morphological operations(erosion or dilation) as pre or post processing, leading to the border enhancing or non- enhancing abnormalities having very few bright pixels. This technique had disadvantage that it yields very poor performance when detecting non-enhanced Abnormality.

In this paper it is pointed out that for detection of abnormality in brain using K-means clustering algorithm ,it is necessary to essentially define the number of cluster K .But as it not possible to initially define the number of clusters in this case it is inefficient.

P. Marcon et al.[8] proposed technique to detect brain Abnormality using chan-vese algorithm. There are three steps involved in it

- Data acquisition: - MR images is normally stored and transmitted in (DICOM) format. This is standard for handling, storing, printing and transmitting information in medical image. It includes file format protocol and a network communication (Application layer protocol).
- Image registration: -It is a technique to transform different set of data into one coordinate system. MR image may be affected by small patient movements caused by heart beating or breathing during MRI test. So it is necessary to perform image registration for MR images. It can be done in two ways
- Detect interhemispheric fissure
- Intensity base segmentation method
- Segmentation based on chan-vese algorithm:-this algorithm for segmentation create 3D binary matrix of abnormality .the output of this algorithm is image depicting abnormality with high contrast.

This technique detects the brain Abnormality very efficiently and accurately. But, it has a disadvantage that, it needs image registration and chan-vese algorithm has high time complexity.

Rupinderal Singh et al. [9] proposed Abnormality detection technique using an artificial neural network and used modified canny edge detection technique to detect the edge of skull. The motive to detect edge of skull in MR images is to significantly reduce the amount of data in image. Canny edge detection algorithm preserves the structural properties of image that can be used for further preprocessing .an artificial neural network works in the same way as biological nervous system i.e. as brain processes information ANN can be configured for abnormality detection through training. .This technique successfully classified infected brain from the set of healthy brain.

2.1 Advantages

- Self organization:-An artificial neural network has ability to create own way to represent information it receives during training.
- Real Time operation:- with the help of special hardware devices ANN computation can be carried out in parallel which result in producing output in real time.
- Fault Tolerance:-partial damaged to ANN leads to degradation of performance of system but by redundant information coding it is possible to make the system fault tolerant to some extent.
- Adaptive learning:-ANN has to ability to learn depending on task to be performed.

2.2 Disadvantages

- The proposed methodology does not give any information about size of abnormality.
- ANN needs special hardware devices to carry out computation in parallel for real time operation
- The proposed methodology is highly complex and is computationally intensive
- The whole system to detect unhealthy part of brain depends on the firing rule of the neuron
- The output node resulted in either 0 or 1.

3. ANALYSIS

After conducting the literature survey several issues were found which are not properly addressed by developed techniques. Some of these are:

- It is seen that while acquiring medical images from the computer aided machines image can be subjected to some noise due to random disturbance of electronic devices, influence of the surrounding environment human factor etc. But most of the techniques do not consider it which results in poor performance of the system.
- Most of the technique used complicated which high time complexity and classification technique which require special training and therefore additional processing time

Most of the segmentation technique requires prior knowledge user interaction i.e. they are not fully automatic

From the literature survey it is found that several techniques are developed to reliably detect the brain Abnormality in real time. Some of the major problems are:-

- **High time complexity***:* Region growing based Abnormality detection technique suffers from high time Complexity and cannot be implemented in real time.
- **Image registration**: In most of the algorithms, registration is necessary in order to compare healthy and unhealthy brain .
- **Training***:* Special training is required therefore additional processing time is required
- **Intensity standardization***:* Many techniques require standardization of intensity of pixel in MR image.

4. PROPOSED SCHEME

With exponential increase in number of brain diseases indexing the database of MR images, so that data can be searched according to different attributes like location or size real time is very important. The knowledge about the size and location of abnormality is also important for further treatment.

In this image an attempt will be made to develop an efficient brain Abnormality detection technique which can detect the Abnormality in real time.

The following steps will be followed:-

- Read MR images (DICOM)
- Remove noises (if noise occurs)
- Detect skull boundary
- Determine centeroid of the boundary
- Draw a line through centeroid
- Comparison of the images on both side of line of Symmetry
- If image is not similar on both the side
    - Detect the region of abnormality
    - Depict Region of abnormality by enclosing it in a Bounding box

Table I. Table Summarizing Literature Survey

Approach	Input	Methodology	Output	Disadvantage	Advantage
K somojundran	MR images	pixel to pixel approach	MR images depicting tumor	based on contrast	Low time complexity
P.marcon	MR images	chan-vese algorithm	Highlight timorous region in MR images	Needs image registration	Detect brain tumor very efficiently and accurately
Rupinderal Singh	MR images	Artificial neural network	Classified healthy brain from infected brain	Output node resulted in either 0 or 1.	Very efficient
Rechna Rana	MR images	fuzzy c-mean algorithm	MR images depicting fully enhance tumor	work only for fully enhance tumor	work well for fully enhancement tumor

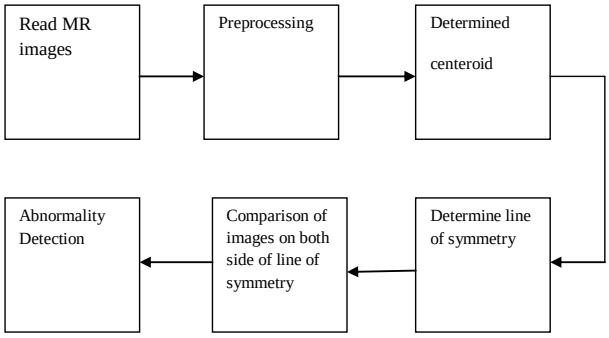

Fig 3 Scheme for a Brain Abnormality Detection System

5. CONCLUSION

Automatic brain abnormality detection technique is an extremely powerful tool which can be used to index the large database of MR images that are maintained by clinics and research centre all over the world .The proposed scheme to detect the unhealthy or infected part of brain by checking for symmetricity between left and right halves of brain has linear complexity and works in real time .In this scheme preprocessing of the MR images is done in order to make MR image free from noises i.e. salt and pepper noise, Poisson noise which may occur during MR test and if not removed may reduce the efficiency of the system .Thus this scheme can be used for detecting the abnormality present in the brain and if present it depicts the abnormal region within the brain ,within bounding box. The scheme proposed in this paper is under development .Hope results will be found as expected.

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