BRAIN TUMOR DETECTION by MRI and CT SCAN IMAGES

Deepa P\textsuperscript{1}, Malashree\textsuperscript{2}, Dr. Bindu A. Thomas\textsuperscript{3}

\textsuperscript{1,2}Department of ECE, VVIET, Mysuru
\textsuperscript{3}Professor and HOD, Department of ECE, VVIET, Mysuru

Abstract— Brain tumor is an abnormal growth of cells, reproducing themselves in an uncontrolled manner. In medical image processing the data is too much for manual interpretation and analysis, thus the accurate detection of location and size plays a very important role in diagnosis of brain tumor. Magnetic Resonance Imaging (MRI) and Computed Tomography (CT scan) are the most widely used techniques for diagnosis. The analysis process includes noise identification, segmentation and feature extraction and classification of the diagnosed images. In this paper the MRI and CT scan techniques are compared in brief for the detection and visualization of the brain tumor.

Keywords— Brain tumor, Magnetic Resonance Imaging (MRI), Computed Tomography (CT scan), Segmentation, Feature Extraction

I. INTRODUCTION

Image processing is a process where the output is obtained by processing the input images. The entire image processing techniques aims to easier visualization of the images under consideration. First step involved in image processing is noise identification and removal i.e. filtering and second step is image segmentation. The basic steps involved in Image processing are as shown in Fig1. Image segmentation plays a significant role in image processing as it helps in the extraction of suspicious regions from the medical images [1]. Image segmentation also plays a vital role in enhancing image measurement, feature extraction and image display.

\hspace*{1cm}

\begin{center}
\begin{tikzpicture}
\node (noise) at (0,0) {Noise removal from Image};
\node (segmentation) [below of=noise] {Image Segmentation};
\node (feature) [below of=segmentation] {Feature Extraction of image};
\node (classification) [below of=feature] {Classification of image};
\draw [->] (noise) -- (segmentation);
\draw [->] (segmentation) -- (feature);
\draw [->] (feature) -- (classification);
\end{tikzpicture}
\end{center}

\textit{Fig1. Steps involved in Image Processing}
Abnormal growth of cells in an uncontrolled manner is the main cause of brain tumor. Brain tumors are initiated from brain cells, blood vessels, nerves that emerge from the brain. Tumors can damage the normal brain cells by producing inflammation, exerting pressure on parts of brain and increasing pressure within the skull [3]. The main problem in tumor detection arises due to each tumor being of different shape, size, location and intensity. Manual detection of brain tumor requires human interaction and is time consuming. Also it depends on the ability of the observer to locate the location, shape and size of the tumor [2]. In order to know the effects of brain tumor, one should have the knowledge about the functions of each part of the brain.

II. STRUCTURE OF BRAIN

The patient is examined by radiologists by using MRI and CT scan. The resulting scanned image provides the information such as tumors location and helps to plan the surgical approach for its removal. In order to understand the brain tumor we need to first have the knowledge of normal structure of brain without tumor and the different functions associated with different parts of the brain. The human brain has three major parts which is responsible for various control actions. The Structure of the brain is as shown in Fig.2 and MRI image of the brain is as shown in Fig.3.

2.1. Cerebrum
This is also called as Cortex, and is the largest part of the human brain, associated with the functions of thought and action. It is divided into right and left cerebral hemispheres. This is responsible for learning, thinking, emotions, problem solving, reading, and writing. The right cerebral hemisphere controls the muscles of the left side of the body and the left cerebral hemisphere controls the muscles of the right side of the body.

2.2. Cerebellum
The cerebellum is responsible for controls movement, standing, balance and complex actions and is also associated with regulation and coordination of the movements. Cerebellum is similar to the kernel of OS. This is also called as the little brain.

2.3. Brain stem
Brain stem is responsible for control of blood pressure, body temperature, and breathing and controls some basic functions. Brain stem joints the brain with spinal cord. This is the limbic system, and is made up of midbrain, pons and medulla.
III. MRI AND CT SCAN METHODOLOGY

The MRI and CT scan are the two methods used to detect and visualize the brain tumor in an efficient and effective manner. The MRI uses the radio frequency and magnetic field to result images of the human body without ionized radiations [3]. In CT scan a series of X-rays at different angles of required part helps to get a perfect image. Thus both provides a better images of the required part in order to detect and visualize the affected part. The method involved in MRI and CT scan can be explained in brief as follows,

3.1. Image Preprocessing:
Based on the requirement the preprocessing step converts the image, i.e. it performs filtering of noise in the image. The MRI includes the medium filter for noise removal, whereas CT images preprocessing includes high level filters. Noise results due to the thermal effects and variations in the source signals. The possibility of noise in modern MRI scan is less compared to CT scan. This also includes RGB to grey conversion and reshaping. The image preprocessing for MRI images and CT images are as shown in the figure 4 and figure 5 respectively.

![Fig4. a) Original image b) Resized image c) Gray scale image d) Filtered image obtained from MRI Scan](image1)

![Fig5. a) Original image b) Resized image c) Gray scale image d) Filtered image obtained from CT Scan](image2)

3.2. Segmentation:
Image segmentation methods are classified into three categories, they are: Edge-based methods, Region based methods and Pixel-based methods [5]. The K-means clustering is the method used here, for segmentation of the images obtained through MRI Scan. The process involved is as shown in figure 6. K-means clustering is one of the simplest techniques and it is a pixel - based method of segmentation used to segment the images obtained from MRI Scan.

Steps for K-means [4]:
1. Give the no of cluster values as K.
2. Randomly choose K cluster centers
3. Calculate mean or center of the cluster
4. Calculate the distance between each pixel to each cluster center
5. If the distance is near to the center than move to that cluster
6. Otherwise move to next cluster
7. Re-estimate the center
8. Repeat the process until the center doesn’t move.

![Fig6. a) Filtered image b) Clustered image c) complement image obtained by MRI Scan](image1)

The Edge detection is a approach used here for segmenting the images obtained through CT Scan [9]. This aims at identifying points in a digital image at which the image brightness changes sharply or more formally has discontinuities. Two basic properties of image intensity values are the basis for current segmentation algorithms are similarity and discontinuity. The similarity category is based on the principal of dividing an image into regions that are similar to a set of predefined criteria. Discontinuity approach is based on partitioning the image based on abrupt change in intensity. The images obtained through edge detection process are as shown in figure 7.

![Fig7. a) Filtered image b) Tumor detected c) Area of interest obtained by CT Scan](image2)

### 3.3. Feature Extraction:
In pattern recognition and in image processing, feature extraction is a special form of dimensionality reduction. When an input data to an algorithm is too large to be processed and it is suspected to be notoriously redundant then the input data will be transformed into a reduced representation set of features [4].

![Fig8. a) Extracted image by MRI Scan b) Extracted image by CT Scan](image3)
Transforming the input data into the set of features is called feature extraction [6]. This is helpful in identifying brain tumor where is exactly located and helps in predicting the next stage. It includes the knowledge about the features such as, contrast, entropy, energy, shape, colour, etc. The feature extracted images obtained by K – Means Clustering segmentation of MRI scan and Edge detection type of segmentation for CT scan is as shown in the figure 8.

3.4. Classification of images
This is the final step in the detection and visualization of the medical images obtained by MRI and CT scan techniques. Initially the images obtained are processed, to remove the noise and then they are segmented and clustered to extract the part that is not similar to that of the normal pattern. Then the resulting signals from feature extraction are use full in detecting the type of Tumor or part of brain affected by the presence of the tumor. Thus these are the various process involved in detection and extraction of the brain tumor by MRI and CT scan. Also through observation we can define that MRI scan provides more accurate and effective results compared to CT scan.

IV. COMPARISONS OF MRI AND CT SCAN IMAGES
MRI and CT scan follows the same procedure of image processing; the main factor that differs is the type of source used to scan. And also they differ in few parameters which are shown in brief in the Table 1. The MRI scan is preferred more compared to the CT scan technique, because MRI doesn’t ionizes the tissues and the efficient image clarity is obtained, compared to CT scan images. But CT scan uses X-rays for scanning which is harmful compared to radio waves of MRI. The other differences are mentioned below.

<table>
<thead>
<tr>
<th>SL. No</th>
<th>Parameters</th>
<th>MRI Scan</th>
<th>CT Scan</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>scan source</td>
<td>Uses power full magnetic fields and radio frequency pulses.</td>
<td>Uses X-rays</td>
</tr>
<tr>
<td>2</td>
<td>sensitivity</td>
<td>More sensitive to the patients movement</td>
<td>Less sensitive to the patients movement.</td>
</tr>
<tr>
<td>3</td>
<td>Clarity of the image</td>
<td>Good Clarity</td>
<td>Moderate Clarity</td>
</tr>
<tr>
<td>4</td>
<td>Cost</td>
<td>High</td>
<td>Half of that of MRI.</td>
</tr>
<tr>
<td>5</td>
<td>Response</td>
<td>Moderate response</td>
<td>Quick response</td>
</tr>
<tr>
<td>6</td>
<td>Details of soft tissues</td>
<td>Provides good details</td>
<td>Images bone soft tissue and blood vessels all at same time</td>
</tr>
<tr>
<td>7</td>
<td>Effects</td>
<td>No biological hazards.</td>
<td>Poses risk of irradiation.</td>
</tr>
<tr>
<td>8</td>
<td>Application</td>
<td>Used for soft tissue evaluation</td>
<td>Widely used on emergency room patients.</td>
</tr>
</tbody>
</table>
V. FUTURE SCOPE

Future research in the medical image processing leads to the reduction in complexity of image segmentation by enhancing the accuracy, exactness, computational speed and by minimizing the amount of manual interaction. This enhancement can be achieved by incorporating discrete and continuous-based segmentation methods. The research area for segmentation is increased to support the automated diagnosis and radiotherapy.

VI. CONCLUSION

Segmentation and Feature Extraction approaches are relevant directly to the medical applications. The techniques of the MRI and CT scan image enhancement in terms of pixel-based segmentation have been reviewed. The paper gives the basic idea about the detection and identification of the brain tumor, the various process involved in image processing of MRI and CT scan are explained in brief and also, gives the brief comparisons of the MRI and CT scan techniques of the image processing.

REFERENCES