The Methodology of the proposed Research

Statement of hypothesis

A set of eight texture features will be extracted from the tumor and the normal regions.

a. Gray - Tone spatial dependence matrix

A gray tone spatial dependence matrix approach, introduced by Haralick which is a well known statistical method for extracting second order texture information from images, is used for this study. This method is based on the estimation of the second order joint conditional probability density function \( C(ij / d,0) \) where \( 0 = 0, 45, 90 \) and \( 135 \) degrees. Each \( C(i, j / d,0) \) is the probability of going from gray level \( i \) to gray level \( j \), given that the inter-sample spacing is \( d \) and the direction is given by the angle \( 0 \). This is also referred to as co occurrence matrix. The co occurrence matrix is calculated for the normal and tumor regions (ROI) in the brain images for \( e = 0 \) degrees and distance \( d = l \). Eight texture features are calculated from the co occurrence matrix.

Let us denote the co occurrence matrix \( C \) and \( N \) be the number of distinct gray levels in the quantized image.

\[
C x(i) = \sum_{j=1}^{N} C(i, j) \quad (1)
\]

\[
C y(i) = \sum_{l=1}^{N} C(i, j) \quad (2)
\]

\[
C x + y(k) = \sum_{l=1}^{N} \sum_{j=1}^{N} C(i, j) \quad l+j=k \quad k = 2, 3, \ldots, 2N \quad (3)
\]

\[
C x - y(k) = \sum_{l=1}^{N} \sum_{j=1}^{N} C(i, j) \quad |l-j|=k \quad k = 0, 1, \ldots, N - 1 \quad (4)
\]
The following eight texture features are calculated

1. Angular second moment (ASM)

\[ f_1 = \sum_{i=1}^{N} \sum_{j=1}^{N} \{C(i,j)\}^2 \]  \hspace{1cm} (5)

2. Contrast (CON)

\[ f_2 = \sum_{n=0}^{N-1} n^2 \left\{ \sum_{i=1}^{N} \sum_{j=1}^{N} C(i,j) \right\} \]  \hspace{1cm} (6)

3. Inverse Difference Moment (IDM)

\[ f_3 = \sum_{i=1}^{N} \sum_{j=1}^{N} \frac{1}{1 + (i-j)^2} C(i,j) \]  \hspace{1cm} (7)

4. Sum Variance (SVAR)

\[ f_4 = \sum_{i=2}^{2N} (i - f)^2 \]  \hspace{1cm} (8)

\[ f = \sum_{i=2}^{2N} ic_{x+y}(i) \]

5. Sum Entropy (SENT)

\[ f_5 = - \sum_{i=2}^{2N} c_{x+y}(i) \log(c_{x+y}(i)) \]  \hspace{1cm} (9)

6. Entropy (ENT)

\[ f_6 = - \sum_{i=1}^{N} \sum_{j=1}^{N} C(i,j) \log (C(i,j)) \]  \hspace{1cm} (10)

7. Difference Entropy (DENT)
Where $H_X$ and $H_Y$ are entropies of $C_X$ and $C_Y$.

8. Information Measure of correlation (IMC)

$$f^8 = \frac{H_{XY} - H_{XY1}}{\text{MAX}(H_X, H_Y)}$$

$$H_{XY} = - \sum_{i=1}^{N} \sum_{j=1}^{N} C(i, j) \log \{C(i, j)\}$$

$$H_{XY1} = - \sum_{i=1}^{N} \sum_{j=1}^{N} C_X(i, j) \log \{C_X(i)C_Y(j)\}$$

b. Methods of Data Collection:

The MRI Images of Brain which is the input data of this work will be collected from Medical Institutions for Cancer Treatment, Medical Research Centers, Specialist Doctors, and Research Institutes like IITs.

c. Probable methods of Data Analysis: After implementation of the proposed algorithms on MR Brain images, the results will be compared and tallied with the actual results in consultation with the specialist doctors in this field.

Scheme of Proposed Research Work.

The Process of detection of Brain Tumor using MR image analysis can be broadly divided into following steps(Ref.fig 1)

- Preprocessing of MR images.
  - Image acquisition
  - Adaptive filter
- Image Analysis of MR images
  - Segmentation
  - Feature Extraction
• Enhancement
• Development of neural network algorithm for Classification and Detection of Brain Tumor.

Hardware approach

![Diagram of the Hardware approach](image)

Software Approach

![Diagram of the Software approach](image)

Fig 1: Scheme of proposed system for Brain Tumor Detection.

The resizing of the Image is performed to convenient size so that processing and analyzing can be carried out effectively. The Adaptive Filter is applied to remove the spurious signals present in the image. Then the segmentation and the feature extraction of region of interest (ROI) is obtained so that enhancement of required section can be done through software. The next block of the system is neural network control. The neural network is trained for the detection of tumor present in human brain.

After testing and successful implementation of the proposed scheme with ANN using Mathlab, the real time operation can be performed on the MR Brain Images for the detection of Brain Tumor.
Plan of Research:-

The following table depicts the brief outline of the research work to be undertaken.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Brief Details of Work</th>
<th>Time Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Detailed literature review on the Process of detection of brain tumor using MR image analysis and Image acquisition</td>
<td>3-months</td>
</tr>
<tr>
<td>2</td>
<td>Development of experimental set up for filtering of noise and unwanted signals from the acquired image using Adaptive filter</td>
<td>3-months</td>
</tr>
<tr>
<td>3</td>
<td>Implementation of Segmentation, Feature Extraction, Enhancement for the detection of brain tumor images.</td>
<td>3-months</td>
</tr>
<tr>
<td>4</td>
<td>Development of Neural Network based MATLAB model</td>
<td>3-months</td>
</tr>
<tr>
<td>5</td>
<td>Neural Network training &amp; testing detection of brain tumor images.</td>
<td>6-months</td>
</tr>
<tr>
<td>6</td>
<td>Evaluation of the system performance by applying MRI images with brain tumor and without brain tumor &amp; comparing results with that of existing system.</td>
<td>6-months</td>
</tr>
</tbody>
</table>

5. Chapter Scheme

1. Introduction
2. Literature Review
3. Image Processing- An Overview
4. MRI Techniques
5. System Design
6. System Implementation & Results.
7. Performance Evaluation
8. Discussion & Conclusion