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Exploration on Selection of Medical Images employing New Transformation Technique

J.Jaya[1] , K.Thanushkodi [2]

1. Research Scholar, Anna university, Chennai.

2.Director,Akshya College of Engg & Tech, Coimbatore

Abstract

Transformation model plays a vital role in medical image processing. This paper describes a new Transformation model (NTM) which is hybrid of linear and non linear Transformations techniques for the detection of tumor. In NTM, patient image is compared with reference images, which is block based. An image similarity measure quantifies the degree of similarity between intensity patterns in two images. The choice of an image similarity measure depends on the modality of the images to be registered. In this paper contrast checking, sum of squared intensity differences (SSD), calculation of white cells and point mapping are used.

Key Words: *New Transformation model (NTM), Contrast checking, SSD, White cells, point mapping.*

1. Introduction

Image Transformation technique is a basic task in image processing used to match two or more images taken at different sensors of from different view points. Transformation algorithms can also be classified according to the Transformation model used to relate the reference image space with the target image space. The first broad category of Transformation models includes linear Transformations, which is also called as linear Transformation. It is the combination of translation, rotation, global scaling and shear components. Linear Transformations are global in nature, thus not being able to model local deformations. The second category includes a non linear Transformation which is known as non rigid Transformation. These Transformations allow local warping of image features, thus providing support for local deformations. Non linear Transformation approaches include polynomial warping; interpolation of smooth basis functions. In another category of image Transformation is the process of aligning images from a single modality or from different modalities. In this NTM, single modality is described.

The incidence of brain tumors is increasing rapidly, particularly in the older population than compared with younger population. Brain tumor is a group of abnormal cells that grows inside of the brain or around the brain. Tumors can directly destroy all healthy brain cells. It can also indirectly damage healthy cells by crowding other parts of the brain and causing inflammation, brain swelling and pressure within the skull. Over the last 20 years, the overall incidence of cancer, including brain cancer, has increased by more than10%, as reported in the National Cancer Institute statistics (NCIS), with an average annual percentage change of approximately 1%.2-6 between 1973 and 1985, there has been a dramatic age-specific increase in the incidence of brain tumors [1]. Death rate extrapolations for USA for Brain cancer: 12,764 per year, 1,063 per month, 245 per week, 34 per day, 1 per hour, 0 per minute, 0 per second[2]. The National Cancer institute statistics reported as the average annual percentage increases in primary brain tumor incidence for ages 75-79, 80-84, and 85 and older were 7%, 20.4%, and 23.4%, respectively.5-8 Since 1970, the incidence of primary brain tumors in people over the age of 70 has increased sevenfold. Canadian Cancer Statistics, National Cancer Institute of Canada (NCIC) in 2004, 5 per 100,000 deaths in men from brain tumor or cancer in Canada and 4 per 100,000 deaths in women from brain tumor in Canada.

Now a day, MRI is the noninvasive and very much sensitive imaging test of the brain in routine clinical practice. Magnetic resonance imaging (MRI) is a noninvasive medical test that helps physicians diagnose and treat medical conditions. MR imaging uses a powerful magnetic field, radio frequency pulses and a computer to produce detailed pictures of organs, soft tissues, bone and virtually all other internal body structures. It does not use ionizing radiation (x-rays) and MRI provides detailed pictures of brain and nerve tissues in multiple planes without obstruction by overlying bones. Brain MRI is the procedure of choice for most brain disorders. It provides clear images of the brainstem and posterior brain, which are difficult to view on a CT scan. It is also useful for the diagnosis of demyelization disorders (disorders such as multiple sclerosis (MS) that cause destruction of the myelin sheath of the nerve). This paper is organized as follows. In the first phase, film artifacts and unwanted portions of MRI Brain image are removed. Secondly, the noise and high frequency components are removed using weighted median filter (WM). Finally, NTM is applied for tumor selection.

2. Related Works

In medical imaging different approaches have been implemented for the selection of tumor images. This section describes different methods for MR brain image Transformation.. Peter et al described a new high-dimensional non-rigid Transformation with two properties. Multi-modality and locality and he got best performance than previous method [3].Wilbert described automated application for the Transformation of MRI for Alzheimer patients with rigid-body Transformation and non-rigid body" using classical match filter and (CMR) correlation filter and he found root-mean-squared (RMS) error through Match filter and correlation filter [4].Yeit et al specified automatic Transformation method for MR images using shape matching system with Gaussian model, this method successfully found necessary points fro register normal images and reference image[7].Thomas et al designed a new automatic and interactive methods for image Transformation for 3D MRI and SPECT Comparison for shows an accuracy[5]. Wang et al described a Free-form deformation based on optimization used to speed up the Transformation process and avoid local minima. This performance evaluate with simulated images and real images [6]. Kovalev et al introduced a technique with Free-Form Deformation for non-rigid Transformation here Subdivision of NURBS is extended to 3D and is used in hierarchical optimization to speed up the Transformation and avoid local minima[8]. Peter et al described a new high-dimensional non-rigid Transformation with two properties. Multi-modality and locality and he got best performance than previous method .Wilbert explained comparison of Transformation methods for MRI brain images used nonlinear Transformation and warping models. it can get 31% more efficient than linear Transformation.

3. Materials and Methods Used

3.1 Image Acquisition

The 0.5T intra-operative magnetic resonance scanner of the Kovai Medical Center and Hospital (KMCH, Signa SP, GE Medical Systems) offers the possibility to acquire 256*256*58(0.86mm, 0.86mm, 2.5 mm) T1 weighted images with the fast spin echo protocol (TR=400,TE=16 ms, FOV=220*220 mm) in 3 minutes and 40 seconds. The quality of every 256*256 slice acquired intra-operatively is fairly similar to images acquired with a 1.5 T conventional scanner. MRI Images of a patient obtained by MRI scan is displayed as an array of pixels (a two dimensional unit based on the matrix size and the field of view) and stored in Mat lab 7.0.

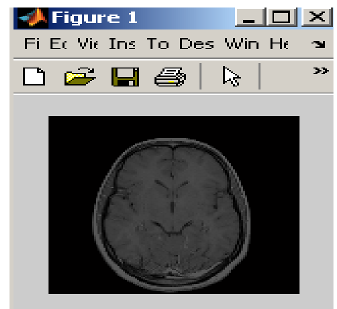


Fig1.MR Brain image on MAT LAB

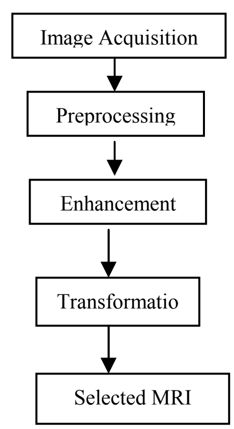
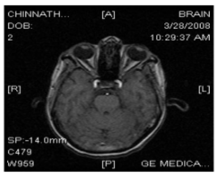


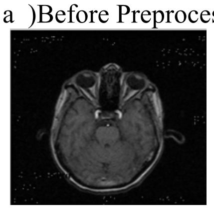
Fig2. Block diagram of NTM

3.2 Preprocessing

The MRI brain image consists of film artifacts or label on the MRI such as patient name, age and marks. film artifacts that are removed using tracking algorithm .Here, starting from the first row and first column, the intensity value of the pixels are analyzed and the threshold value of the film artifacts are found. The threshold value, greater than that of the threshold value is removed from MRI. The high intensity value of film artifacts are removed from MRI brain image. During the removal of film artifacts, the image consists of salt and pepper noise .The above image is given to enhancement stage for removal of high intensity components. The following figures explain the process of preprocessing stage.



a)Before Preprocessing



(b)After Preprocessing

Fig3. Removal of Artifacts from MRI

3.3 Enhancement

Image enhancement methods inquire about how to improve the visual appearance of images from Magnetic Resonance Image (MRI). This proposed system describes the information of enhancement using weighted median filter for removing high frequency components such as impulsive noise, salt and pepper noise, etc. The merit of using weighted median filter is, it can remove salt and pepper noise from MRI without disturbing of the edges. In this enhancement stage, the weighted median filtering is applied for each pixel of an 3 ×3, 5 ×5, 7 ×7, 9 ×9, 11 ×11window of neighborhood pixels are extracted and analyzed the mean gray value of foreground , mean value of background and contrast value.

Peak Signal-to-Noise Ratio (PSNR) and Average Signal-to-Noise Ratio (ASNR) values of the weighted median filters are calculated.

$$C = (f-b) / (f + b)$$

f = mean gray -level value of the foreground
b= mean gray-level value of the background

$$\sigma = \sqrt{(1/N) \sum_i (bi-b)^2}$$

Noise level= standard deviation (σ) of the background
bi = Gray level of a background region
N= total number of pixels in the surrounding background region (NB)

PSNR = (p-b) / σ, which is calculated as 0.924
ASNR =(f-b)/ σ , which is calculated as 0.929

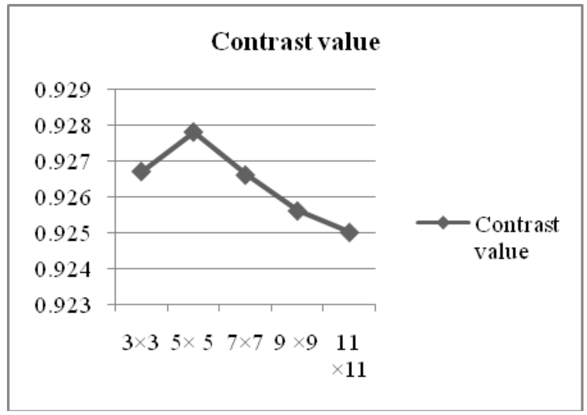


Fig.4 plot for Contrast values derived from weighted median filter

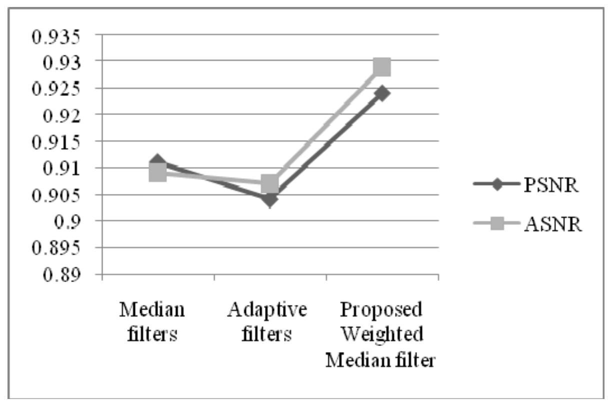


Fig5. Performance Evaluation of Enhancement Stage

4. Proposed New Transformation Model

4.1 Non.Rigid Transformation Model

In Non linear Transformation, Block based technique is used. Here .both the given reference MR brain image (256 × 265) and the normal image (256 × 265) has been divided into several blocks. Each and every block of both the images is 64 ×64. After blocking, subtraction has been done between the two images. This subtracted value is then checked with the threshold value, in our method. Then first block from both the images were subtracted and the average value of all the pixels in that block were calculated. This average value is then compared our threshold value of 80,000 and if any of which is found to cross this limit, those patient details will be stored in the database as a doubtful case.

4.2 Rigid Transformation Model

It is one of the simplest forms of Transformation model. The shape of a human brain changes very little with head movement, so rigid body Transformations can be used to model different head positions of the same subject. Matching of two images is performed by finding the rotations and translations that optimize some mutual function of the images. Within modality, Transformation generally involves matching the images by minimizing the sum of squared difference between them. For between modality Transformations, the matching criterion needs to be more complex. For rigid body Transformation, rotations and translations are adjusted. The changes could arise for a number of different reasons, but most are related to pathology. Because the scans are of the same subject, the first step for this kind of analysis involves registering the images together by a rigid body Transformation. This is based on the similarity measures parameters.

5. Implementation and Results Discussion

5.1 Non.Rigid Transformation –Block based technique

The following Table1 explains the NR technique .Here the normal image is compared with the Tumor image. The comparison is block based. If changes occur it is processed by Rigid Transformation technique.

5.2 Non Rigid Transformation -Average Intensity Measure

Average intensity measure for blocks of both normal and target image was calculated and compared. If there is any abnormality found in the normal image then it is stored in segmented database. Otherwise it is stored in normal database. In the following table, block 1 to block 4 of both source and target image does not have difference in average intensity but in block5 to block 8 has different values. Those values are stored in segmented database. Similarly block 9,10 has different values, and block11 to 16 has no difference in the intensity values.

Table 1.Block based Transformation for segmentation

Image	1	2	3	4	5	6	7	8
Normal	31	67	51	2	68	71	86	5
T1	31	67	51	2	77	91	86	5
T2	31	67	51	2	68	71	86	5
T3	31	67	51	2	68	101	91	5

Image	9	10	11	12	13	14	15	16
Normal	49	87	62	4	8	38	14	2
T1	57	97	62	4	8	38	14	2
T2	75	105	62	4	8	38	14	2
T3	49	90	62	4	8	38	14	2

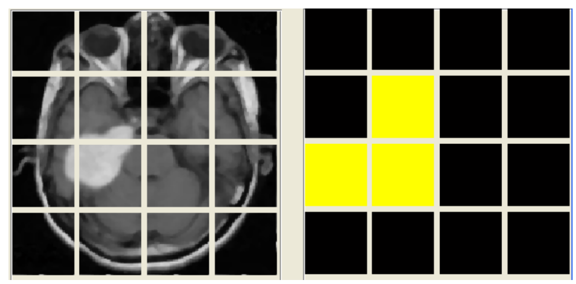


Fig6. Block based Transformation for segmentation

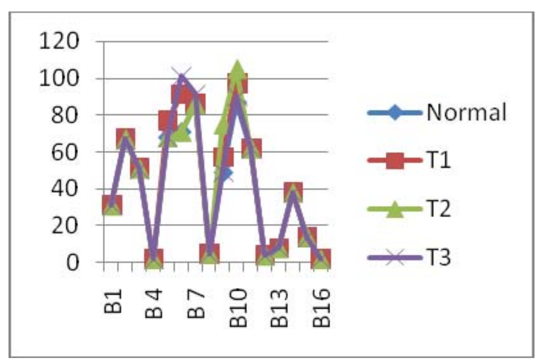


Fig7.Segmentation by Block based Transformation images

5.3 Rigid Transformation –Similarity Measures

This rigid method consists of the following similarity measures, such as Contrast difference, Sum of square difference, Correlation using point, similarity measure .An application of rigid Transformation is the field of morphometry, and involves Identifying shape changes within single subjects by subtracting co registered images acquired at Different times.

5.4 Contrast checking

Contrast checking is one of the methods in similarity measure. Contrast for the reference images and normal image is computed based on average background and average foreground value of MRI. Contrast checking for a given image is calculated by the given formula.

$$C = (f-b) / (f + b)$$

C = Contrast of the given image
f = mean gray -level value of the foreground
b= mean gray-level value of the background

Table 2.Contrast Analysis in Rigid Transformation technique

Image name	Mean Back Ground (b	Mean Fore ground (f)	Contrast (C)
Normal	0.8899	42.3447	0.9588
Target 1	0.9238	45.3103	0.9600
Target2	0.9238	45.1490	0.9599
Targetr 3	0.9238	44.7062	0.9595

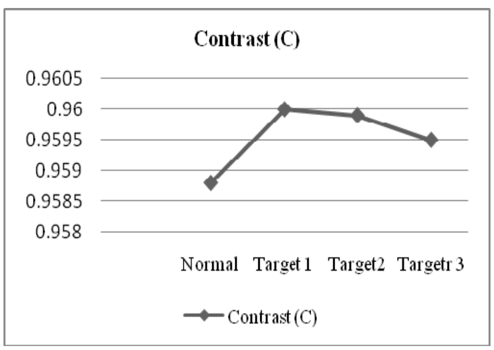


Fig8. plot of contrast value obtained by Rigid Transformation technique.

5.5 Sum of Squared Difference (SSD)

Sum of Squared Differences (SSD) is one of the simplest of the similarity measures which is calculated by subtracting pixels within a square neighborhood between the reference image I1 and the target image I2 followed by the aggregation of squared differences within the square window, and optimization. In this section, the sum of squared difference (SSD) is applied for each pixel of an 3 ×3, 5 ×5, 7 ×7, 9 ×9, 11 ×11window of neighborhood pixels in target image and reference image.
The average value of SSD is found for both the images. Sum of square difference is given by :

SSD= Sum of square of pixels / Total number of pixels in the given window.

Table 3. Calculation of SSD in Rigid Transformation technique

Image name	Sum of square Difference (SSD)	Average of SSD
Normal	195139692	2977.595398
Target 1	232541734	3548.305267
Target2	230918327	3523.534042
Targetr 3	224479823	3425.290268

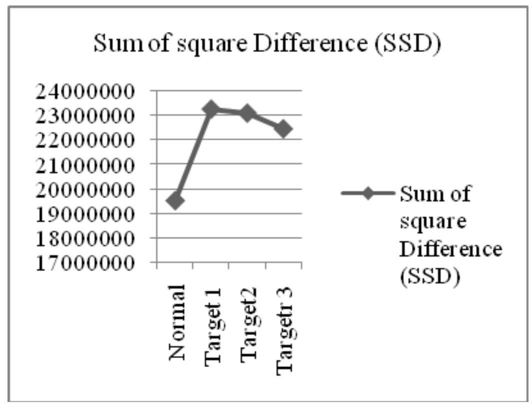


Fig9. Plot of SSD obtained by rigid Transformation technique

5.6 White cells Measure

The intensity of white cells are measured which is useful for further steps.

Table 4 .White cells calculation in Rigid Transformation technique

Image name	No of white pixels
Normal	418
Target 1	594
Target2	1113
Targetr 3	612

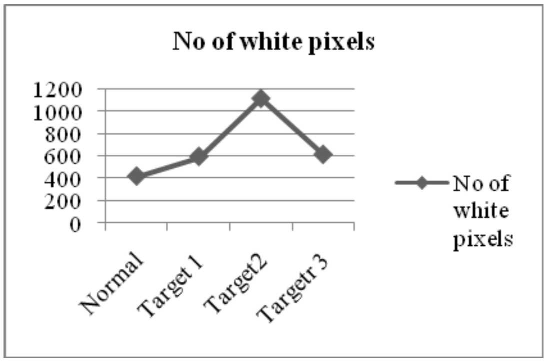


Fig10 .plot of white pixels in rigid Transformation technique

5.7 Point mapping

Point mapping is the basic statistical approach to Transformation and it is a match metric technique it gives a measure of the degree of similarity between an image and a template. Point similarity measures can be derived from global measures and enable detailed relative comparison of local image correspondence. For performing Image Transformation, We have to get the enhanced image in the same size as that of the original image (image without tumor). Here, we have taken two reference points first, in front view and second in the top view of the image. The enhanced image has to be resized to the original image size by fixing the same reference points as in the original image. Since in our technique, the size of the original image is 256*256, the enhanced image has been resized to (256-x)*(256-y) by removing the extra portions in the image.

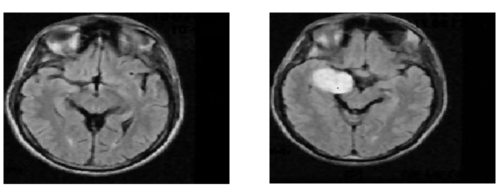


Fig 11 Before Point Mapping

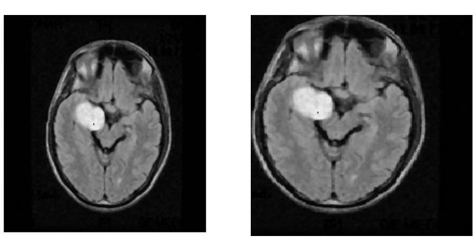


Fig 12 After Point Mapping

6. Conclusion

This paper proposed a New Transformation model for MR brain image selection.. Initially, MR brain image is acquired. Secondly the film artifacts and unwanted portions of brain are removed using tracking algorithms and the image is assigned as a new image. With this new image the weighted median filtering is applied to remove high frequency components. Finally the images are entered in to Transformation. Here, the reference (tumor) and normal image (patient) are involved to linear Transformation method and non linear Transformation method. In non linear method the block based technique is implemented. The reference image and normal images are split as several blocks of size 64 ×64. Intensity pair of each block of those images is compared. If any changes occur in those blocks then it will be assigned as a new image and it is given to the next stage. In linear method, the intensity pattern of both the images are analyzed using similarity measures like contrast checking (CC), Sum of Squared Difference (SSD) and measurement of T1 weighted image. The merit of the proposed technique is very simple because MR images are registered using similarity measures with block based technique. The above methods produce accurate result than previous methods and it produces the same output every time.

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