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Medical Image Registration using Feature Extraction Method

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***Abstract* – Image registration is process of combining different sets of data of the same object, which come from different image modalities; for example, CT, MRI, SPECT, PET and so on. This paper describes the effect of image registration on both MRI and CT scan medical image of human brain collected from University College Hospital Ibadan, Oyo state, Nigeria. The images of both scans were Dilated, Filtered, Blurred, Edged Correlated and Decomposed before it was registered. The result shows that CT scan has the highest intensity, followed by MRI scan while the registered image has the lowest intensity due to its low contrast. The Mean for the images were calculated and standard deviation for CT, MRI and registered image are 87.9199, 90.7229 and 109.8826 respectively. This shows that data points for the unregistered images are very close to the mean while the data points for the registered image spread over a large range of value.**

***Keywords* – MRI Scan, CT Scan, Registered Image, Mean, Standard Deviation.**

I. INTRODUCTION

Image registration is a crucial step in some image analysis tasks in which the final information is gained from the combination of various data sources like in image fusion, change detection, and multichannel image restoration [4]. Typically, registration is required in remote sensing multispectral classification, environmental monitoring, change detection, image mosaicking, weather forecasting, creating super-resolution images, integrating information into geographic information systems (GIS), in medicine to combine CT and MRI data to obtain more complete information about the patient, monitoring tumor growth, treatment verification (comparison of the patient's data with anatomical atlases), in cartography (map updating), and in computer vision (target localization, automatic quality control), to name a few [5]. Multiform methods of image diagnosis provide doctors and clinicians with various anatomical and functional information to carry out exact diagnosis and effective treatment [6].

Image registration algorithms are pre-processing algorithms that improve image quality and transform the object of images into one coordinate system and its applications can be divided into four main groups according to the manner of the image acquisition [5]

(i) *Different viewpoints (multi-view analysis):* Images of the same scene are acquired from different viewpoints.

(ii) *Different times (multi-temporal analysis):* Images of the same scene are acquired at different times, often on regular basis, and possibly under different conditions. The aim is to find and evaluate changes in the scene which appeared between the consecutive image acquisitions

(iii) *Different sensors (multimodal analysis):* Images of the same scene are acquired by different sensors. The aim is to integrate the information obtained from different source streams to gain more complex and detailed scene representation.

(iv) *Scene to model registration (Template analysis):* Images of a scene and a model of the scene are registered.

The concept of image registration is described in Figure 1.

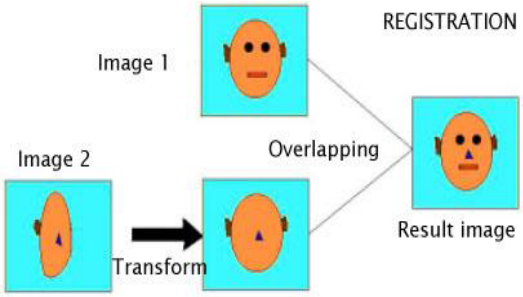


Fig.1. The concept of registration [6]

Feature Extraction

Feature extraction a type of dimensionality reduction that efficiently represents interesting parts of an image as a compact feature vector. This approach is useful when image sizes are large and a reduced feature representation is required to quickly complete tasks such as image matching and retrieval [3]

Mean

The mean is the average value of a given set of numbers or a group of numbers. In image analysis, the mean plays an important role which helps to identify the value of the given pixels found in an image.

Standard Deviation

There are two common textbook definitions for the standard deviation s of a data vector X. where

$$s = \left(\frac{1}{n-1} \sum_{i=1}^{n} (x_i - \bar{x})^2 \right)^{\frac{1}{2}}$$

$$s = \left(\frac{1}{n} \sum_{i=1}^{n} (x_i - \bar{x})^2 \right)^{\frac{1}{2}}$$

and n is the number of elements in the sample. The two forms of the equation differ only in n-1 versus n in the divisor [5].

II. METHODOLOGY

Feature Extraction for medical image registration

The first step in the registration process is the feature extraction process. This process involves identifying

various features in an image, by getting the point extraction, curve extraction, contour extraction. Most of these extractions are used for the effective transformation that enhances the medical images that were registered. Furthermore, components of the images were identified and cross referenced against each other [1]. The steps involves are;

Step 1: Acquisition of images

This is the process of getting the images from different imaging modalities. This process a multimodal images from MRI and CT.

Step 2: Getting the value of images into the computer

This process involves digitalization of the images. Each pixel in the images has a specific value that must be gotten and evaluated. The detail of this is explicitly described in [1]

Step 3: Get image components and equivalent.

This step helps to enhance image processing. These components are identifiable and are attached to each images; this implies that for every image, there is a definite component that differentiate it from other images

*Step 4: Get image features for images to register***.**

To get the image features for the images, the steps involve,

a) Dilate image to get some hidden details and features

The process of dilating image helps us identify useful features in an image. Unwanted features or characteristics of images are always available and could cause a hindrance to image analysis. Dilation of image helps in achieving most complex form especially after the image has been converted to gray scale.

b) Filter image.

Filtering image using a special filter type, helps to remove unwanted surface appearances in images. Most images have unwanted surfacing that makes it difficult to get the exact components, or value we are looking for.

c) Blur image with noise to recover some quality of image lost during filtration

The process of blurring image enables the image to recover some lost quality that took place during filtration. A regularized filter can be used effectively when limited information is known about the additive noise.

d) Edge Correlation

For image detection, registration, more robust feature points are referred than noisy edge information. Another criterion named “edge correlation” is introduced.

e) Decompose images using the quad tree decomposition

Quad tree decomposition is an analysis technique that involves subdividing an image into blocks that are more homogeneous than the image itself. This technique reveals information about the structure of the image. It is also useful as the first step in adaptive compression algorithms. You can perform quad tree decomposition using the quad tree decomposition function (qtdecomp) [2]. This function works by dividing a square image into four equal-sized square blocks, and then testing each block to see if it meets some criterion of homogeneity (e.g., if all the pixels in the block are within a specific dynamic range). If a block meets the criterion, it is not divided any further. If it does not meet the criterion, it is subdivided again into four blocks, and the test criterion is applied to those blocks. This process is repeated iteratively until each block meets the criterion. The result might have blocks of several different sizes.

Step 5: Matching images to be registered.

This involves matching images together by picking specific features common to the images as a result, the standard image i.e registered image and analytical enhancement of image brings out this function, which helps to achieve the required result.

The equivalent flowchart for medical image registration adopted in this work is given in Figure 2.

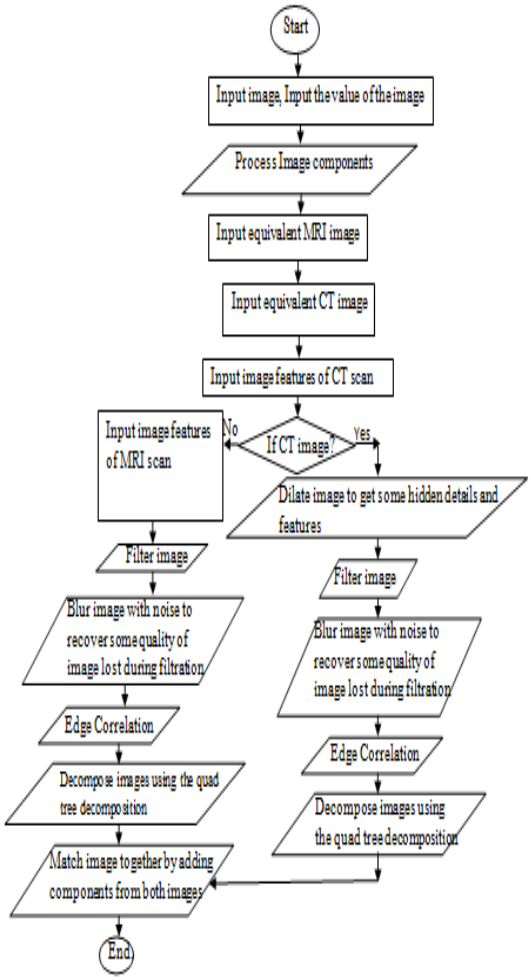


Fig.2. Flowchart for feature extraction medical image registration

III. Discussion of Results

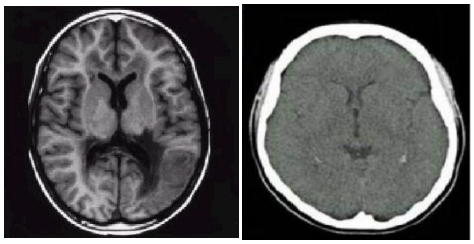
Medical Image Registration results

The trans-axial slice of MRI scan and CT scan of normal human brain Medical images were obtained and registered. The results were as follows. Figure 3 (a) is a MRI scan of a human brain that serves as the test image for the registration, while Figure 3 (b) is a CT scan of a

human brain that was used as the refrence image for the registration.

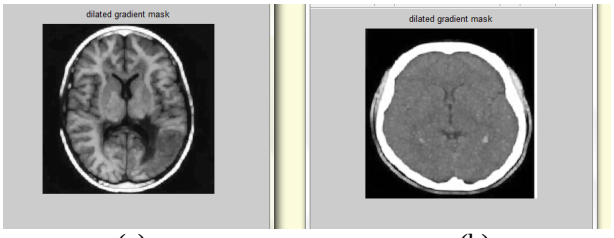
Figures 4 (a) and (b) show the dilated image for CT and MRI image respectively. The process of dilating image helps in identifying useful features in an image. Unwanted features or characteristics of images are always available and could cause a hindrance to image analysis. Dilation of image helps in achieving most complex form especially after the image has been converted to grayscale. Figures 5 (a) and (b) give the image component for CT and MRI image respectively. This is very important because it helps to enhance image processing. These components are identifiable and are attached to each image, which make it very useful in image analysis. Figures 6 (a) and (b) are blurred images for CT and MRI image respectively. The images were blurred with noise to recover some lost quality during filteration. Finally, the registered image is shown in Figure 7.

The Mean for the images were calculated and standard deviation for CT, MRI and registered image are 87.9199, 90.7229 and 109.8826 respectively. This shows that data points for the unregistered images are very close to the mean while the data points for the registered image are spread over a large range of value. Figure 8, 9 and 10 show the intensity histogram for CT scan, MRI scan and the registered image respectively. The result shows that CT scan has the highest intensity, followed by MRI scan while the registered image has the lowest intensity due to its low contrast.



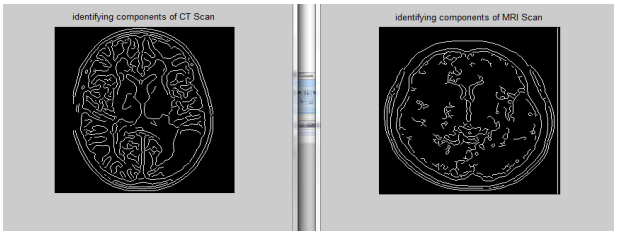
(a) (b)

Fig.3: Images to be registered (a) MRI scan (b) CT scan



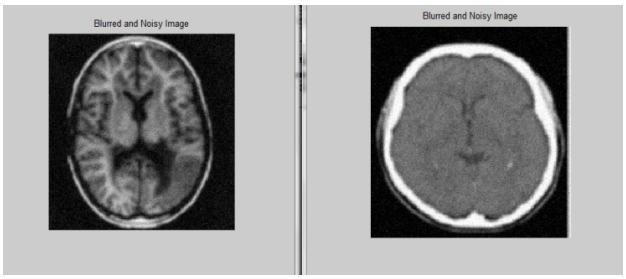
(a) (b)

Fig.4. Dilated image (a) MRI image (b) CT image



(a) (b)

Fig.5. Image component (a) MRI image (b) CT image



(a) (b)

Fig.6. Blurred and noise image (a) CT image (b) MRI image

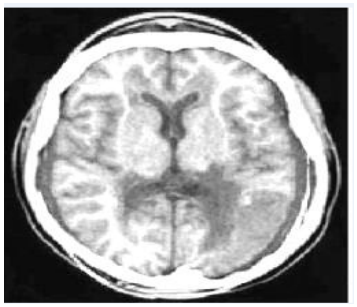


Fig.7. Image registration results

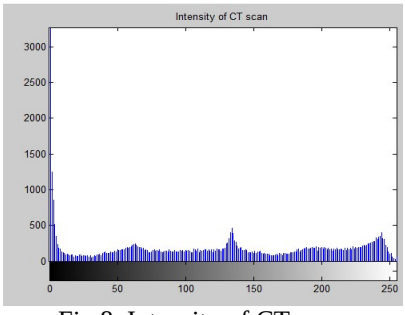


Fig.8. Intensity of CT scan

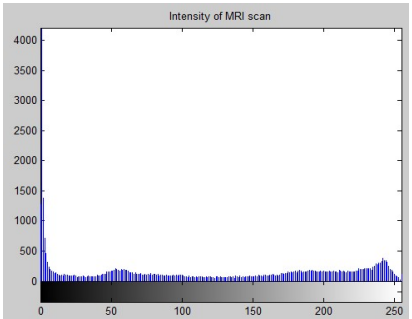


Fig.9. Intensity of MRI scan

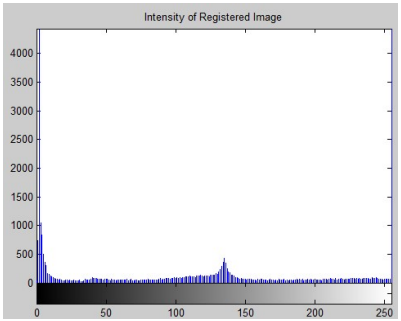


Fig.10. Intensity of registered image

The intensity of Registered Image decreases as a result of low contrast.

IV. CONCLUSION

Image registration is very important for medical image analysis especially for health care service delivery in developing country where there are limited medical imaging modalities. The process of combining different sets of data of the same object, which come from different medical image modalities; for example, CT, MRI, SPECT, PET and so on. This paper describes the effect of image registration on both MRI and CT scan medical image of human brain collected from University College Hospital Ibadan, Oyo state, Nigeria. The images of both scans were Dilated, Filtered, Blurred, Edged Correlated and Decomposed before it was registered. The result shows that CT scan has the highest intensity, followed by MRI scan while the registered image has the lowest intensity due to its low contrast. The Mean for the images were calculated and standard deviation for CT, MRI and registered image are 87.9199, 90.7229 and 109.8826 respectively. This shows that data points for the unregistered images are very close to the mean while the data points for the registered image spread over a large range of value.

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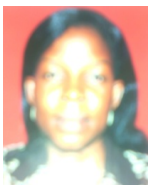

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