Brain Tumour Detection from Image Data

Project Thesis

Submitted By

14-27626-3	Khan,Tanvir Ahmed
15-30760-3	Mahmud Chowdhury Md. Rabby
16-31192-1	Madani,Shahin

Department of Computer Science

Faculty of Science & Technology

American International University Bangladesh

Spring,2018-2019

July 14, 2019

Declaration

We declare that this thesis is our original work and has not been submitted in any form for another degree or diploma at any university or other institute of tertiary education. Information derived from the published and unpublished work of others has been acknowledged in the text and a list of references is given.

Khan, Tanvir Ahmed

14-27626-3

Computer Science

Mahmud Chowdhury Md. Rabby

15-30760-3

Computer Science and Engineering

Madani, Shahin

16-31192-1

Computer Science and Engineering

Approval

The thesis titled “Brain tumour Detection RGB to GRAY” has been submitted to the following respected members of the board of examiners of the department of computer science in partial fulfilment of the requirements for the degree of Bachelor of Science in Computer Science on (20/03/2019) and has been accepted as satisfactory.

A. G.M Zaman
Assistant Professor & Supervisor
Department of Computer Science
American International University-Bangladesh

Sajib Hasan
Assistant Professor & External
Department of Computer Science
American International University-Bangladesh

Dr. M M Mahbubul Syeed
Associate Professor & Head (Undergraduate)
Department of Computer Science
American International University-Bangladesh

Professor Dr. Tafazzal Hossain
Dean
Faculty of Science & Technology
American International University-Bangladesh

Dr. Carmen Z. Lamagna
Vice Chancellor
American International University-Bangladesh

Acknowledgement

First of all, we would like to express our gratitude to Almighty Allah to enabling us to complete this report on “**Brain Tumour Detection From Image Data”**.

Successfully completion of any type of project requires helps from a number of persons. We have also taken help from different people for the preparation of this report. Now, there is a little effort to show my deep gratitude to that helpful person.

We convey our sincere gratitude to A. G. M. Zaman, our supervisor, who gave us an opportunity to work on this project which allow us to gain much research experience in this field. His valuable advice and guidance has always been very helpful. In every phase of this project his supervision and guidance shaped this report to be completed perfectly.

Table of Contents

Abstract

Medical image processing is the most challenging and emerging field today. This paper describes the methodology of detection & extraction of brain tumour from patient's MRI scan images of the brain. In this paper, a method for segmentation of brain tumour has been developed on 2D-MRI data which allows the identification of tumour tissue with high accuracy and reproducibility compared to manual techniques. This method incorporates with some noise removal functions, segmentation and morphological operations which are the basic concepts of image processing. Detection and extraction of tumour from MRI scan images of the brain is done by using MATLAB software. The aim of this work is to design an automated tool for brain tumour quantification using MRI image data sets.

Chapter 1: Introduction

1.1 Background of the study

The purpose of this study is to segment brain tumour detection using digital image processing and find the injury part for a certain image. Many researchers have already tried to solved this problem by applying different algorithms. But still this problem needs strenuous effort to find detect injury from brain tissues.

1.2 Statement of the Problem

For this research, we plan to collect dataset of plain still image model to make the process easier at the beginning and Magnetic Resonance Imaging (MRI) is an advanced medical imaging technique used to produce high quality images of the parts contained in the human body [1]. From these high- resolution images, we can derive detailed anatomical information to examine human brain development and discover abnormalities [2]. MRI consists of T1 weighted, T2 weighted and PD (proton density) weighted images and are processed by a system which integrates fuzzy based technique with multispectral analysis [3].

1.3 Objectives of the Study

The study will play vital role in medical operations and as well as tracking human brain pattern where it needs. This work will help to detect the injury of the brain which can be further useful for recognition process. In general setting, it will help in artificial intelligence operation where the normal pattern of the neuronal activity can be detected without the help of human eye.

1.4 Significance of the Study

The significance of the study is to figure out different algorithm or method to find tumour from the neuron of the brain which can open a big possible research area in Artificial Intelligence and Image processing sector. This can be useful further brain injury recognition purpose.

1.5 Scope of the Study

The scope of the study is to help medical department is a general setting. Brain segmentation can be useful in critical medical operation. In future this program can be done more advanced so that major tumour can be classified according to its type [4]. Advancement in programming can help the segmentation completely automatic. By plotting the graph, the growth of the tumour can be analyzed [5].

1.6 Formation of this Paper

The formation of this paper is as follows. In Chapter 2 we converse about related preceding work. In Chapter 3 we give a detail overview of our methodology . Chapter 4 provides the details derivation of our Result and analysis. Finally, we talk over limitations and future work in chapter 5.

Chapter 2: Literature Review

Some of the previous research related to this problem, we explain the fundamental concepts of feed-forward neural networks and basic deep models in the literature. The contents are specifically focused on learning hierarchical feature representations from data. It is also described how to efficiently learn parameters of deep architecture by reducing over fitting.

2.1 Unsupervised feature representation learning

Some of the previous research related to this problem is the recovering body configurations by Greg Mori and his teams [1]. They were able to detect human figure and localize his joins and limbs along with their associated pixel masks from an image which was a collection of sports news photographs of baseball players. Image was first analyzed at low level. Then they applied the canny edge detector at two different scales. Texture on clothing and background clutter pose severe problems for recognition. They used the boundary finder of Martin et al which combines both brightness and textures information to reduce clutter. Then Normalized Cuts Algorithm was used to group similar pixels into regions. Many salient parts of the body pop out as single regions, such as the legs and the lower arms that’s why they had to use over-segmentation. To validate their approach, they used hand labeled images to evaluate the classification performance as well as the individual cues being used. Then they evaluate the performance of their segmentation-based torso detector, again using hand labeled joint positions, and compare it to an exemplar-based detector.

2.2 Stacked Auto-Encoder

An auto-encoder, otherwise called auto-associator (65), is an extraordinary sort of two-layer neural system that learns an inert or compacted portrayal of the contribution by limiting the remaking blunder between the info and the yield estimations of the system, i.e., recreation of the contribution from the scholarly portrayals. Note that because of its basic shallow auxiliary trademark, the authentic intensity of a solitary layer auto-encoder is known to be restricted. Be that as it may, while stacking numerous auto-encoders as appeared in Fig. 2(a), which is along these lines called as stacked auto-encoder (SAE), by taking the enactment estimations of shrouded units of an auto-encoder as the contribution to the accompanying upper auto-encoder, it is conceivable to improve the authentic power incredibly (66). Because of the various leveled nature in structure, a standout amongst the most significant qualities of the SAE is to learn or find very non-direct and convoluted examples, for example, the relations among info esteems. At the point when an info vector is introduced to a SAE, the various layers of the system speak to various dimensions of data. That is, the lower the layer in the system, the more straightforward examples; the higher the layer, the more confounded or dynamic examples natural in the information vector.

2.3 A New Approach of Segmentation from Photo Images

Ashwini Magar and Prof.J.V.Shinde also proposed a new approach of human segmentation from photo images[3]. They proposed a simple method to automatically recover human bodies from photos. They used some haar cascades to detect human bodies to detect human body that is haar cascades to detect human body that is haar cascade_upperbody and haar cascade lower body which helps in performing upperbody and lower body segmentation. They needed to perform CT (coarse torso) detection using MCTD (multitude coarse torso detection algorithm) algorithm for accurate upper body segmentation. Lower body is then extracted accurately using MOH (multiple oblique histogram) based graph-cut algorithm. The coarse lower body is extracted based on max-flow/min-cut algorithm by estimating background and foreground seed using result of upper body segmentation as shown in fig.1(c).and then fine lower body is segmented from coarse lower body by using MOH algorithm which update foreground and background seed determination. In their experiments, the scale of the bounding boxes used for CT detection is set to three and four times the width and height of the detected face, respectively.

2.4 Reducing over fitting

A basic test in preparing profound models emerges for the most part from the predetermined number of preparing tests, contrasted with the quantity of learnable parameters. Along these lines, it has dependably been an issue to lessen overfitting. In such manner, late examinations have concocted pleasant algorithmic procedures to all the more likely train profound models. A portion of the procedures are as per the following:

- Initialization and force (73, 74): to utilize a well-structured arbitrary introduction and a specific calendar of gradually expanding the energy parameter as cycle passes
- Rectified direct unit (Re LU) (7, 75, 76): to apply for non-straight enactment work
- Denoising (6): to stack layers of denoising auto-encoders, which are prepared locally to recreate the first 'clean' contributions from the tainted variants of them
- Dropout (8), drop connect (77): to haphazardly deactivate a small amount of the units or associations, e.g., half, in a system on each preparation emphasis
- Batch standardization (9): to perform standardization for every less cluster and back propagating the slopes through the standardization parameters.

For the further details, refer to the respective references.

Chapter 3: Methodology

The algorithm has two stages, first is pre-processing of given MRI image and after that segmentation and then morphological operations. Steps of algorithm are as following:-

1) Give MRI image of brain as input.
2) Convert it to gray scale image.
3) Apply high pass filter for noise removal.
4) Apply median filter to enhance the quality of image.
5) Compute threshold segmentation.
6) Compute watershed segmentation.
7) Compute morphological operation
8) Finally output will be a tumour region

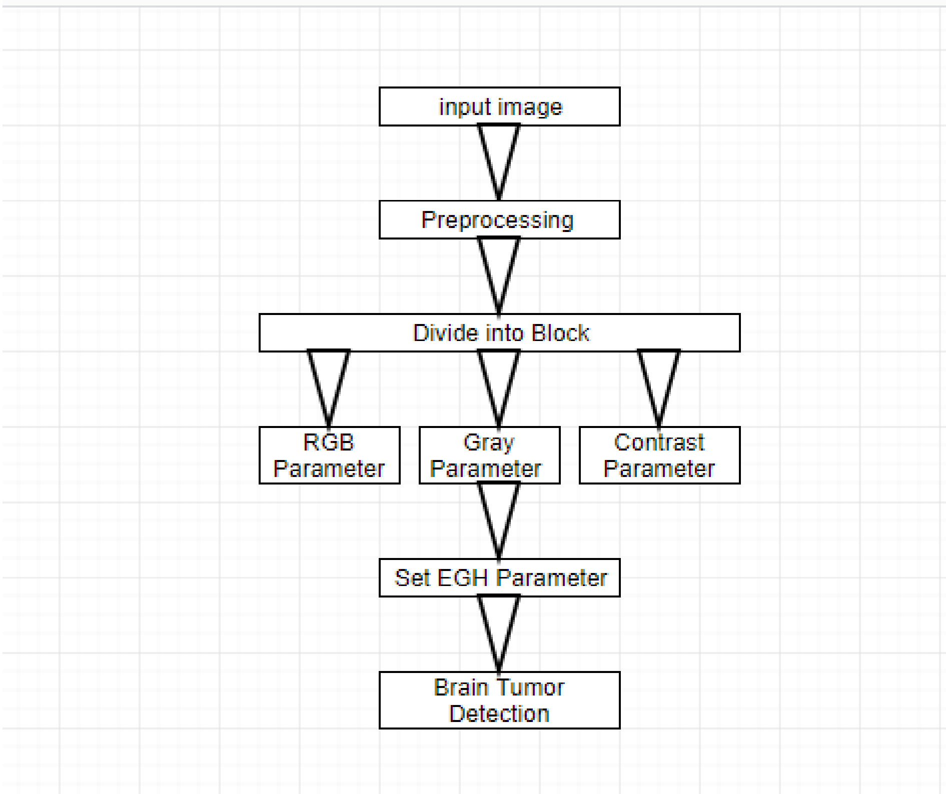

Figure 1: Data flow of the approach

3.1 The Proposed Framework

The process flow of our proposed methodology may be shown as figure 1.

The first section discusses how images are divided into regions using a block-based method. The second section shows how each classified block is studied individually by calculating its multiple parameter values. In this instance, the multiparameter features refer to the following three specific features: the edges (E), gray values (G), and local contrast (H) of the pixels in the block being analyzed

3.2 Input Image

The images we got from MRI are of three types: axial Images, sagittal Images, coronal Images. The number of images depends on the resolution of the movement of the MRI magnets .

Preprocessing In preprocessing the first step is to load the MRI image data set on to the MATLAB workspace and after loading they will be processed. After this processing there are only three clips instead of 384 separate images, i.e. one clip for axial images, one clip for sagittal images and one clip for coronal images.

Axial, sagittal and coronal images were loaded and viewed in the MATLAB. After this, axial, sagittal and coronal movie clips were prepared and are shown in figure 2.

3.3 Multi parameter Calculations

Classifying regions using their multi-parameter values makes the study of the regions of physiological and pathological interest easier and more definable. The multi-parameter features refer to the following three specific values for the edges (E), gray values (G), and local contrast (H) of the pixels . Edge (E) Parameter: We use sable edge detection method to detect image edges (IE) is obtained by filtering an input image with two convolution kernels concomitantly, one to detect changes in vertical contrast (HX) and the other to detect horizontal contrast (HY), shown in equation (1). Image output (IE) is obtained by calculating the gradient magnitude of each pixel, as shown in equation (2). Subsequently, the edge parameter (E) is calculated, whereby E (r,c) is increased by one each time when IE (x, y) = ‘1’ in a supervised block, as shown in equation (3).

3.4 Segmentation of brain tumour using Region of Interest (ROI) Command

As it has been seen from the above result that high density images have been separated from the MRI images using watershed segmentation. Here main aim is to segment the tumour from the MRI images. This can be done by using the ROI command in MATLAB. After the application of the ROI command, the tumour may be segmented. This can be achieved by executing the algorithm in MATLAB.

All the calculations and techniques can be summarized in following steps for the tumour detection:

1. RGBscale Imaging: MRI images are magnetic resonance scan of a patient taken with the help of a computer. Generally a rgb scale looks like blackened white images . The illusion of gray shading in a halftone image is obtained by rendering the image as a grid of black dots on a white background (or vice-versa), with sizes of individual dots determining the apparent lightness of the gray in their vicinity. In the case of transmitted light (for example, the image on a computer display), the brightness levels of the red (R), green (G) and blue (B) components are each represented as a number from decimal 0 to 255, or binary 00000000 to 11111111. For every pixel in a red-green-blue (RGB) rgb scale image, R = G = B. The lightness of the gray is directly proportional to the number representing the brightness levels of the primary colours. Black is represented by R = G = B = 0 or R = G = B = 00000000, and white is represented by R = G = B = 255 or R = G = B = 11111111. Because there are 8 bits in the binary representation of the gray level, this imaging method is called 8-bit greyscale . The darkest possible shade is black, which is the total absence of transmitted or reflected light. The lightest possible shade is white, the total transmission or reflection of light at all visible wavelengths. So because of the above reason first we convert our MRI image to be pre-processed in greyscale image.

2. High Pass Filter: A high pass filter is method for sharpening methods. An image is sharpened when contrast is enhanced between adjoining areas with variation in brightness or darkness. The kernel array of the high pass filter is designed to increase the brightness of the centre pixel relative to neighbouring pixels. The kernel array contains a positive value surrounded by negative values .

3. Medial filter: Median filter is very widely used in digital image processing because, under certain conditions, it preserves edge while removing noise.

4. The task of filtering is performed by the median filter by use of window that is a pattern of neighbors . The window pattern slides, entry by entry, over the entire signals. The middle value of the window is decided by the median value of all the entries at a time.

5. Threshold segmentation: This method is based on clip-level (or threshold value) to turn a gray-scale image into a binary image by selecting a threshold value. Segmentation is the process of partitioning a digital image into multiple segments, called super pixels. [18] Image segmentation is typically used to locate objects and boundaries in images. By thresholding we assign a specific level to each pixel in image according to the similarity in visual characteristics.

6. Watershed segmentation: A grey-scale may be seen as a topographic relief, where the grey level of a pixel is interpreted as its altitude in the relief. In image processing, different watershed lines may be computed. Mayor’s flooding Watershed algorithm is used to compute the watershed segmentation [14]. This algorithm works on a grey scale image. During the successive flooding of the grey value relief, watersheds with adjacent catchment basins are constructed. This flooding process is performed on the gradient image, i.e. the basins should emerge along the edges. Normally this will lead to an over segmentation of the image, especially for noisy image material, e.g. medical CT data. Either the image must be preprocessed or the regions must be merged on the basis of a similarity criterion afterwards.

7. Morphological Operations: Morphological operation is defined as the relative ordering of all the pixel values, not on their numerical values, and therefore are especially suited for the processing of binary images. Morphological techniques probe an image with a small shape or template called a structuring element. The structuring element is positioned at all possible locations in the image and it is compared with the corresponding neighbor hood of pixels. Some operations test whether the element "fits" within the neighbor hood, while others test whether it "hits" or intersects the neighbor hood. A morphological operation on a binary image creates a new binary image in which the pixel has a non-zero value only if the test is successful at that location in the input image.

Chapter 4: Result and Analysis

The discussed methods made it clear that by considering an MRI image of tumour affected brain, that is show in the figure and performing all the operations in a sequence we get the greyscale image of the MRI image of the brain tumour.

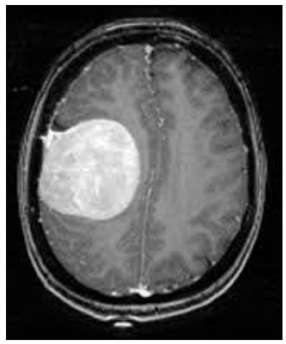

Figure 1 greyscale image of a brain tumour

On passing through a high filtering on the greyscale image of figure 1 the HPF output is shown in figure 2

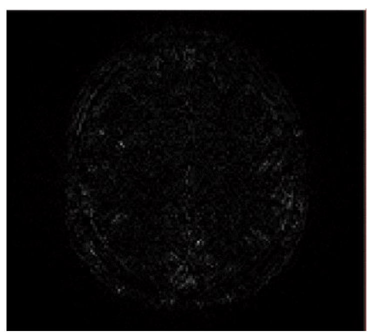

Figure 2 HPF output.

There may even be some noise in the grey scale image of the brain, after removing the noise the MRI image becomes

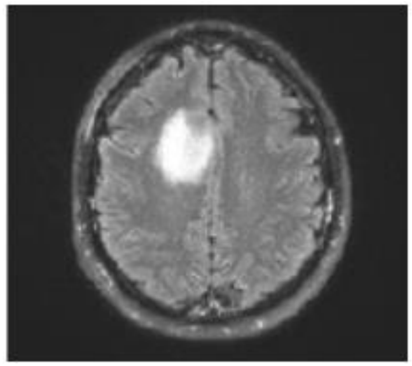

Figure 3 enhanced MRI image

The MRI greyscale is again converted into binary image by using threshold segmentation shown in figure 4

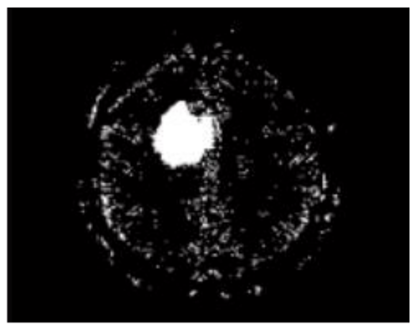

Figure 4 threshold segment of the MRI image

For more accurate result we use the watershed segmentation on the threshold segmented image. And the output is show in figure 5

Figure 5 watershed segmented image

After watershed segmentation the pixel value of the image is done by the morphological operation and the output in each step is shown in figure 6

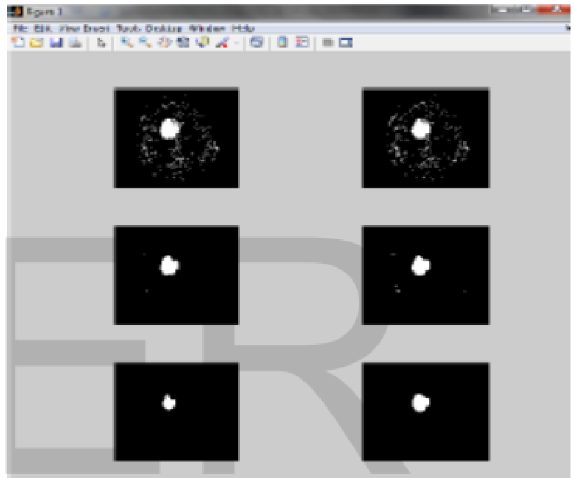

Figure 6 Morphological operations

Lastly by observing the difference in brightness or darkness in the MRI image, the brain tumour can be detected as given in figure 7.

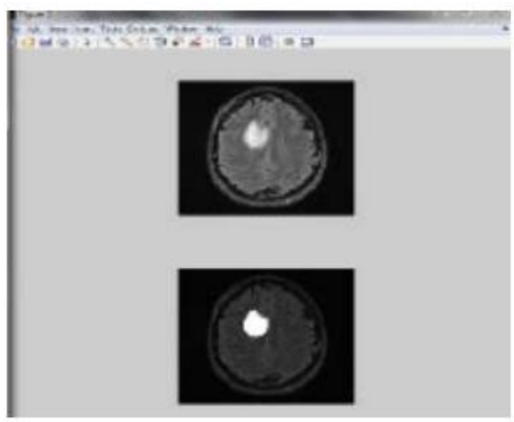

Figure 7 Final Extracted brain tumour from MRI image

Chapter 5: Conclusion

In this project we learnt about various techniques that are being used to detect the brain Tumour from MRI images of brain are evaluated. The proposed technique has the capability to produce effective results even in case of high density of the noise. The proposed project will detect the presence of brain Tumour with increased accuracy. In this research from the effects found are much exact and clear. Accuracy found in final result depends on marching of each step. For each step, there are numerous methods available and the methods allowing for best effects were preferred. The last step is detection of edges of the tumour. The Cellular Automata rule number 252 provides firm edge detection. The algorithm was employed on numerous images and the effects found were very good and effective. Also the suggested algorithm can be applied with some change for detection of lung cancer. The algorithm can be employed to the CT scan of the lungs and region bearing from cancerous cells can be named. A new system that can be used as a second conclusion for aimed. It influences whether an input MRI brain image constitutes a healthy brain or tumour brain. High grade tumours have more true edges than low grade. MRI of healthy brain has an obviously quality almost bilateral symmetric However, if there is macroscopic tumour, the symmetry feature will be weakened. Allowing to the determine on the symmetry by the tumour, we develop a section algorithm to detect the tumour region automatically. The suggested novel approach of improved de-noising method was equated with the being de-noising method. And the effects were employed the algorithm to find out the dissimilarity between original and de-noise images. The experimental results establish the effectiveness of the suggested work. In future, the tumour part is taken for classification of tumour types such as benign and malignant.

References

[1]. W. Gonzalez, “Digital Image Processing”, 2nd ed. Prentice Hall, Year of Publication 2008, Page no 378.

[2]. S. Murugavalli, V. Rajamani, “A high speed parallel fuzzy c- mean algorithm for brain tumour segmentation”,” BIME Journal”,

Vol. no:06, Issue (1), Dec., 2006

[3]. Mohamed Lamine Toure, “Advanced Algorithm for Brain Segmentation using Fuzzy to Localize Cancer and Epilepsy Region”, International Conference on Electronics and Information Engineering (ICEIE 2010), Vol. no 2 .

[4]. Dr.G.Padmavathi, Mr.M.Muthukumar and Mr. Suresh Kumar Thakur, “Non linear Image segmentation using fuzzy c means clustering method with thresholding for underwater images”, IJCSI International Journal of Computer Science Issues, Vol. 7,

Issue 3, No 9, May 2010

[5]. Matei Mancas, Bernard Gosselin, Benoît macq, “Segmentation Using a Region Growing Thresholding”

[6]. T .Logeswari and M.Karnan “An improved implementation of brain tumour detection using segmentation based on soft computing” Journal of Cancer Research and Experimental Oncology Vol. 2(1) pp. 006-014, March, 2010

[7]. Wankai Deng , Wei Xiao, Chao Pan, Jianguo Liu Key “MRI brain tumour segmentation based on improved fuzzy c-means” Method. Laboratory of Education Ministry for Image Processing and Intelligence Control Institute for Pattern Recognition and Artificial Intelligence SPIE Vol. 7497, 74972N, 2009

[8]. Abbasi S and Mokhtarian F (2001) Affine-similar shape retrieval: application to multiview 3-D object recognition. IEEE Trans. Image processing. 10 (1), 31-139.

[9]. Abdel-Halim Elamy and Maidong Hu (2007) Mining brain tumours & their growth rates. IEEE Image Processing Society Journal. pp: 872-875.

[10]. Bailet JW, Alan Lichtenstein, Ge Chen and Robert A. Mickel (1997) Inhibition of lymphocyte function by head and neck carcinoma cell line soluble factors. Arch Otolaryngol Head Neck Surg.123(8),855-862.

[11]. Bailet JW, Abemayor E, Jabour BA, Hawkins RA, Hoh CK and Ward PH (1992) Positron emission tomogarphy: a new precise modality for detection of primary head and neck tumour and assessment of cervical adenopathy. Laryngosope. 102, 281- 288.

[12]. Black PM, Moriarty T and Alexander E (1997) Development and implementation of intraoperative magnetic resonance imaging and its neurosurgical applications. Neurosurgery. 41(4), 831-845.

[13]. Bountris P, Farantatos E and Apostolou N (2005) Advanced image analysis tool development for the early stage bronchial cancer detection. PWASET. 9, 151-156.

[14]. Deng Y, Manjunath BS, Kenney C, Moore MS and Shin H (2001) An efficient color representation for image retrieval. IEEE Trans. Image Processing. 10 (1), 140-147.

[15]. Dewalle Vignion AS, Betrouni N and Makni N (2008) A new method based on both fuzzy set and possibility theories for tumour volume segmentation on PET images. 30th Annual International IEEE EMBS Conference. 3122-3125.

[16]. Epifano I and Ayala G (2002) A random set view of texture classification. IEEE Trans. Image Processing. 11(8), 859-867. [17]. Fadi Abu Amara and Abdel Qadar (2007) Detection of breast cancer using independent component analysis. IEEE EIT Proceedings. 236- 241.