Brain Tumor Detection Method Using Unsupervised Classification Technique

A. S. Mahdi , S.O. Essa
Remote Sensing Unit, Department of Physics, , College of Science, University of Baghdad

Abstract

Magnetic Resonance Imaging (MRI) is one of the most important diagnostic tool. There are many methods to segment the tumor of human brain. One of these, the conventional method that uses pure image processing techniques that are not preferred because they need human interaction for accurate segmentation. But unsupervised methods do not require any human interference and can segment the brain with high precision. In this project, the unsupervised classification methods have been used in order to detect the tumor disease from MRI images. These methods involved K-mean or Isodat, which were based on the digital value distribution. The results show the classification process was a powerful tool to identify the Tumor disease from MRI images. All results were evaluated by using the ENVI Version 3.2 facility.

Introduction

The Magnetic Resonance Imaging (MRI) uses magnetization and radio waves, rather than x – rays to make very detailed, cross – sectional images of the brain, segmented brain images are used to visualize a volume and quantitatively analyze anatomical functional and cortical structures. Segmented brain tissues provide an anatomical frame work for functional visualization which has a potential use in neuroscience research and neurosurgical planning owing to advances in functional MRI (FMRI), (1) Moreover, segmented brain images are widely used in cortical surface mapping, volume measurement, tissue classification and differentiation, functional and more physiological

adaptation assessment and the characterization of neurological disorders such as multiple sclerosis and stroke. MRI brain

segmentation has played a critical role in these technical advancements, (2) A clear image is of a vital importance in medical diagnosis, for this reason an extensive image processing programs were already introduced in (MRI) machines.

Many automatic segmentation methods for medical images have been developed and they all have very good performance, (3, 4) the goal of the automatic system is to make diagnosis quick and effective.

However, some of the automatic systems still require human judgment

(3)

Digital Image processing

Digital image

Digital image can be described as a combination of discrete number (DN), arranged in matrix form (columns and rows), each (DN) called "pixel" when displayed on screen it is associated with "brightness" of a relatively small area within a scene. Mathematically a digital image can be represented as a function of two variables f (x, y), where f, denoted the value of (DN) in that position (x, y). The minimum (DN) value means no energy is reflected or emitted from the object, while maximum value "often (255) for 8-bit" image indicates the saturation energy received from the object, (5)

Segmentation

The segmentation process can be divided into three major steps, (6)Pixel classification: In this step, pixels are classified into a certain number of classes. In general, the number of classes is equal to the pixel number of tissue in the brain, so that there exists a one – to – one correspondence between the classes and the tissues.

A- Correction: In this step, we remove any misclassification whichis caused due to its homogeneities of the radio frequency and magnetic field, imaging noise, etc. n×n majority filters.

B- Tissue labeling: During this step, a class of pixels assigned a unique tissue name. This is donedy using a prior knowledge about density tissue relationship, (7)

Classification

Image analysis and automatic recognition of image's patterns by computer may greatly depend on the results obtained by implementing a certain classification method (8) The classification process, however, depends on the spectral characteristics of image objects and features presented in various bands of the images.

In the literature, image classification methods are categorized into two types; i.e. "Supervised and Unsupervised". Supervised classification involves a considerable amount of input from the analyst and knowledge of the types of surface that found in the study area. On the other hand, the unsupervised classification method groups image small areas (i.e. pixels) into clusters based on the distribution of the gray tones within the image (9) The unsupervised methods are more preferable for classifying images (8) Initially the operator projects the image to be classified onto the display monitor and outlines sample of training areas for each surface class, usually referred as "Region Of Interest (ROI)". These "ROI" are, then, used to provide the classification program with typical examples of each kind of sample to be used in the classification. In fact, the computer program generates statistical parameters from these "ROI" and compares the digital numbers of every pixel within the image with these statistical parameters. If the distribution values of image points, surrounded a certain pixel, falls within a predefined ROI, the pixel is assumed to belong to the same surface class. In fact, selecting the regions of interest is not, always, an easy task, It may require to perform a survey, or utilizing available texture images

K-Mean Classifier: Also called Isodata unsupervised classification, which calculates class means evenly distributed in the data space and then iteratively clusters the remaining pixels using minimum distance techniques. Each iteration recalculates means and reclassifies pixels with respect to the new means. Iterative class splitting, merging, and deleting which are done are based on input threshold parameters. All pixels are classified into the nearest class unless a standard deviation or distance threshold is specified, in such a case some pixels may be unclassified if they do not meet the selected criteria. This process continues until the number of pixels in each class is changed by less than the selected pixel change threshold or the maximum number of iterations is reached. For the details see, (10).

4 Classification Results And Conclusion

Many tumor images have been tested which were produced from MRI (Magnetic Resonance Imaging) devices. The unsupervised classification methods are powerful tools to identify the tumor brain due to the spectral statistical analysis. The class number thresholds was 5-classes, i.e. no brain tumor can be detected under this class number because of the noise effect in the Magnetic Resonance Image. The classification quality can be improved as the number of class increases, this notation is correct only in the unsupervised classification methods. We have used the unsupervised method to process medical images. However as we are not Radiologist we can not assess the value of the image improvement in diagnosis. Figure -1 shows the results of unsupervised classification, These results are given in table 1.

Two main unsupervised classification algorithms were used (K-Mean, & Isodat). The results show that no main differences between them because, these methods depend on images spectral range statistical parameters. All results were evaluated dy using the ENVI Version 3.2 facilities, (ENvironmental Visualize Image), (11). As a Conclusion, 1. the Magnetic Resonance Image results can be improved with image processing techniques such as the selection of classification used in this work. 2. the unsupervised classification is more suitable supervised due to the generalization of the first one.

References

1- Shan , Z. Y.;Yue, G. H., and Liu, J. Z. (2002) Neuro image, 17: 1587 – 1598,

2- Functional MR Imaging (fMRI). Brain: http://www.functionalmri.org/.

3- Brummer, M.E.;Mersereau, R.M.; Eisner, R.L. and Lewine, R.R.j. (1993) IEEE Trans. Med.Image. 12(2): 153 – 166

4- Zhang, S. and Maeda, J., (2000) "A Rule- Based Expert system for automatic segmentation of cerebral MRI image" Proceeding of the 5th IEEE International conference on signal processing, Beijing,2133-2138.

5- Atkins, M.S.and Mackiewich, B. T. (1998) IEEE Trans on Medical Imaging, 17 (1): 98-107.

6- Geoffrey, J. Mclachlan, and Kaye E. Basfoed. (1988)"Mixture Models: Inference and applications to clustering". Marcel Dekker, Inc. New York

7- Clark, M.; Goldgof, D.; Hall; L. O.; Clarke, L. and Silbiger. M. (1994). IEEE Eng. In Medicine and Biology, 13(5): 730 – 742

8 Lillesand, T. M. and Kiefer R. W., 4th. ed. (2000), 4th ed, John Wiley and Sons, INC. pp.578-583

9- Paul, J. Gibson and Clare H. Power, (2000)"Introductory Remote Sensing Digital Image Processing and Application", published by Routledge Taylor and Francis.

10-Jensen, R. J, , (1986) "Introductory Digital Image Processing", 2nd. ed. , Prentice-Hall, New Jersey. pp.234-258

11- ENVI Version 3.2 Software User's Guide, (1999)., Research System Center, Colorado, USA. pp. .476-481

Table 1: The Resultant Image Information

Figure No.	Description
A	K-mean, 7 classes, thresholds 5, image1
B	K-mean, 7 classes, thresholds 5, image2
C	Isodata, 7 classes, threshold 5, image2
D	Isodata, 8 classes, threshold 5, image3
E	K-Mean, 6 classes, threshold 5, image4
F	K-Mean, 6 classes, threshold 5, image3

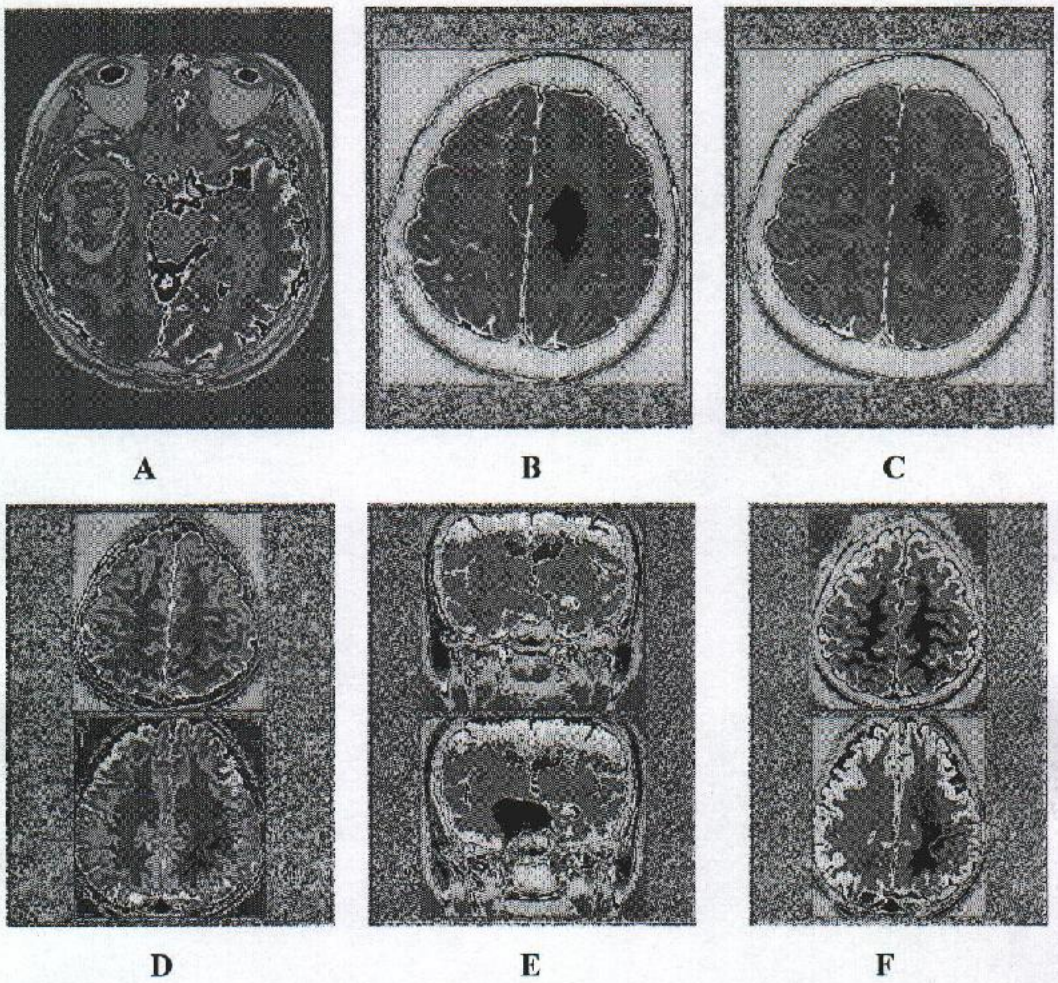

Fig.(1): The Unsupervised Classification Results

مجلة ابن الهيثم للعلوم الصرفة والتطبيقية المجلد21 (4) 2008

الكشف عن ورم الدماغ باستعمال طريقة التصنيف غير المرشد

علاء سعود مهدي، سمر عمران عيسى
قسم الفيزياء،كلية العلوم ،جامعة بغداد

الخلاصة

تضمن البحث استعمال طرائق تصنيف غير مرشدة على صور أجهزة الرنين المغناطيسي والمستخدمة للكشف عن حالات سرطان الدماغ. أن استخدام هذه التقنية الحديثة لأغراض الكشف المبكر عن الأورام السرطانية يعد من التطبيقات الطبية المهمة إلا أن اغلب الصور المستحصلة تحوي على ضوضاء عالية بحيث يصعب في بعض الأحيان تحديد الورم ودرجة تطوره، وكذلك يتطلب ذلك مفسرين متمرسين في هذا الموضوع. الغاية من هذا البحث إيجاد طريق سهلة باستعمال طرائق التصنيف غير المرشدة لأعراض إظهار الأورام السرطانية التي تصيب الدماغ وبسرعة. استخدمت لهذا البحث صور متعددة لمرضى أجانب واستعملت طريقتين تصنيف غير مرشدة هما (K-Mean & Isodata)، أظهرت النتائج أن هذه الطرائق تظهر الأورام وبوضوح وتفرقاهما عن الضوضاء. أن اقل عدد من الأصناف الذي يجب اختياره عند التصنيف هو 4 فما فوق لغرض عزل تلك الأورام عن الضوضاء المرافقة للصور. يمكن استعمال هذه الطرائق من قبل المفسرين الأقل خبرة في هذا المجال وكما يلاحظ من الصور المصنفة.

تم التصنيف باستخدام إمكانيات برنامج المعالجة الصورية (ENVI Version 3.2) .