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Comparison of Some Statistical Measurements Extracted From Benign, Malignant and Normal MRI Brain Images

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Abstract

People may believe that tissue of normal brain and brain with benign tumor have the same statistical descriptive measurements that are significantly different from the of brain with malignant tumor. Thirty brain tumor images were collected from thirty patients with different complains (10 normal brain images, 10 images with benign brain tumor and 10 images with malignant brain tumor). Pixel intensities are significantly different for all three types of images and the F-test was measured and found equal to 25.55 with p-value less than 0.0001. The means of standard deviations and coefficients of variation showed that pixel intensities from normal and benign tumors images are almost have the same behavior whereas they were significantly different from images of malignant brain tumors with F-tests equal to 23.22 and 6.51 respectively with corresponding p-values of 0.00001 and 0.005 respectively.

Keywords: Brain tumor, MRI, Mean, Filtration, Segmentation, Watershed, Pre-Processing.

مقارنة بعض القياسات الإحصائية المستخرجة من صورللدماغ ماخوذه من جهاز الرنين المغناطيسي لاشخاص يحملون امراض حميدة و اخرى خبيثة و صور لغير المرضى

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الخلاصه

قد يعتقد الناس أن نسيج الدماغ للشخص الطبيعي والنسيج للدماغ للشخص المصاب بورم حميد لديهم نفس القياسات الوصفية الإحصائية التي تختلف اختلافا كبيرا عن النسيج للدماغ لشخص مصاب بورم خبيث. جمعت ثلاثين صورة للدماغ من ثلاثين مراجعين مع اعراض مختلفة (10 صورللدماغ الطبيعي، 10 صور مع ورم في الدماغ يعد حميد و 10 صور مع ورم خبيث في الدماغ بحسب تشخيص الاطباء) .

اجري اختبار (F) لنتائج المتوسط الحسابي لجميع الصور و بحسب شدة البيكسل لقد اظهرت اختلافا كبيرا بين الانواع الثلاثة بحسب اختبار (F) المساوي الى 25.55 مع قيمة (p) اقل من 0.0001.

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واظهرت نتائج الانحراف المعياري والمتوسط الحسابي فروقات بحسب تباين المتوسط الحسابي لشدة البيكسل تبين ان صور الاورام الحميدة و صور الاشخاص الطبيعيين يوجد بينهما تقريبا فرق بسيط اي انها تسلك نفس السلوك تقريبا في حين انها تختلف اختلافا كبيرا عن صور الاورام الخبيثة مع اختبارات (F) مساوية 23.22 و 6.21 على التوالي مع مطابقة قيم (p) نجدها 0.0001 و 0.005 على التوالي .

Introduction

The tumor is the abnormal growth of cells and tissues. The brain tumor is an abnormal mass of cells that have grown, proliferated, uncontrollable and appear to be unchecked by the defenses that normally control normal cell growth. Tumors in the brain can be primary or metastatic and either malignant or benign[1]. Thus, these symptoms that appear in the images of the brain differ in terms of illumination and statistical distribution in terms of the natural brain and abnormal and in terms of tumor and benign and malignant. The basic principles in the research are the known techniques obtained from the MRI device and by the density of the proton and their weight in the picture T1 and T2 and are processed by the system [2]. Tissue can be describe by two different relaxation times – T1 and T2. T1 (longitudinal relaxation time) is the time constant which define the rate at which excited protons return to equilibrium. It is a measure of the time possessed for spinning protons to reorganization with the external magnetic field. T2 (transverse relaxation time) is the time constant which define the rate at which excited protons reach equilibrium or go out of phase with each other[3]. It is a measure of the time possessed for spinning protons to lose phase coherence among the nuclei spinning perpendicular to the original field. which is based on multi-spectral analysis technique[4, 5].

The beginning of pretreatment of MRI images is the basic step in image analysis that results in improved images through noise reduction techniques that are used to improve picture quality and then processes that lead to tumor size determination in the brain are applied through an algorithm that has been performed on 30 images 15 of whom were diagnosed by the reports of doctors at Baghdad Medical City Hospital as having malignant tumor, 15 patients with benign tumor, and 15 normal persons, analyzed and obtained data [6] .

Patients and methods

Images from 30 patients with different complains (10 normal brain images, 10 images with benign brain tumor and 10 images with malignant brain tumor) attended the department of MRI at the Baghdad Medical City during the period April to August 2016 were considered see Figure-1 . These thirty images were actually fall into three main categories; normal brain images, brain with benign tumor and brain with malignant tumor. All images were subjected to the following works in order to extract the necessary information regarding the undergoing research work [7]. The following scenario statements procedure were used in order to get the information needed using of MATLAB ver. R2014a [8, 9] .

1. Read image (Give MRI image of brain as input) .
2. Resize image (Resize MRI image to fit the recycling process by PCA)
3. Convert to gay scale (By used the order rgb2gray)
4. Identify threshold (Take the level of threshold to gray >80)
5. Convert to binary image (By using the order im2bw)
6. Use PCA to the converted image (by using the data in the program of DWT & PCA following the order dwt2singal and pca((name of the image))) .
7. Extract values of the determined features (by using the order mean2 and srd2 and the order mean2(var(double)) .
8. Apply the one-way analysis of variance on the extracted data. (By using (SPSS) Statistical Package for the Social software program) .

Benign Malignant Normal

Figure 1-MRI Scan Brain Images.

Mean and standard deviation were the main focus of this paper as they both measure the pixel intensity and its variability[10]. Both can show brief idea about how the normal or abnormal tissue can reflect the tissue ability to either pass or reflect magnetic resonance waves.

Studies that include this aspect take these statistics as a basis for their work and then proceed to a more comprehensive statistics. In this paper, the differences between the main data which lead to the following differences were examined by comparing the analysis of the intensity of the light shown in the picture in the Mean of all the images included in the building algorithm[11].

Normal tissues give structured information about the intensity of light in one pixel, while we notice the differences between the information shown on the images of people with benign diseases or malignant diseases, as well as differences between the apparent information between benign diseases on the side and malignant diseases on the other[12].

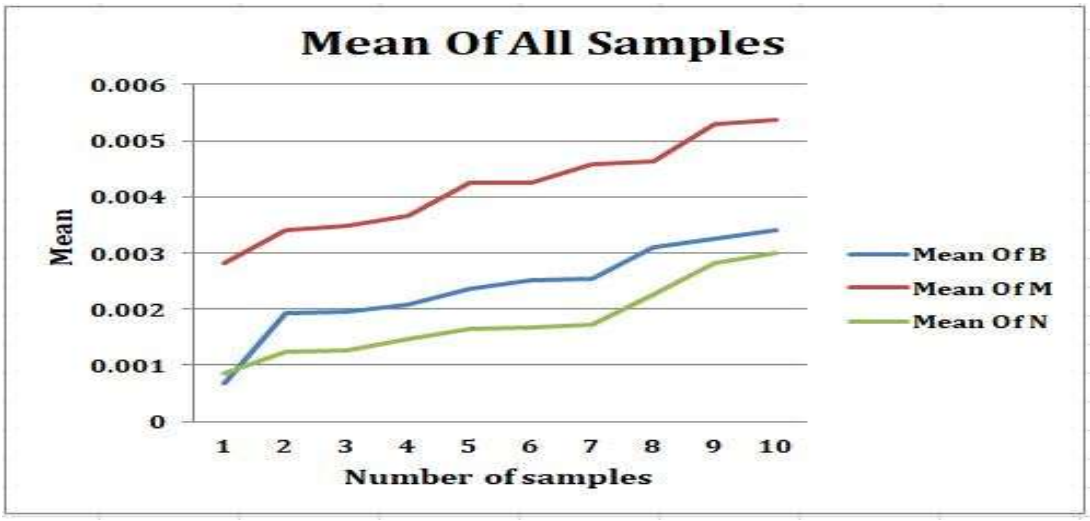
Recently, brain tumor classifications have been used through magnetic resonance imaging (MRI) and the use of basic statistical information accordingly, including mean, standard deviation and variance, and then subjecting them to filtering, classification, and segmentation of images to extract tumor location and his size [13].

Table 1- shows the extracted data from the considered images using the program written by …

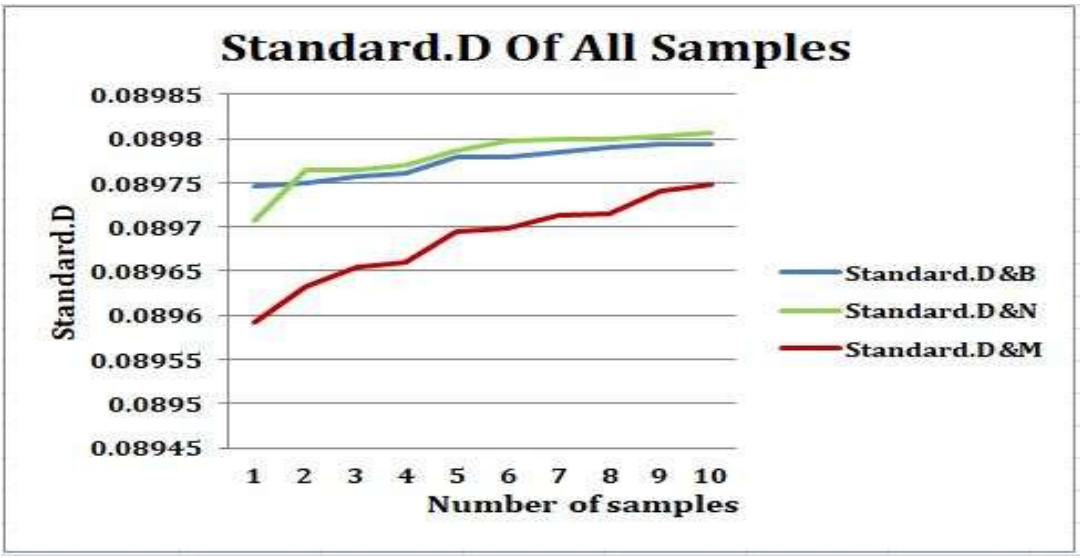
Normal Brain			**Benign disease**			**Malignant disease**		
Mean	**Standard.D**	**Variance**	**Mean**	**Standard.D**	**Variance**	**Mean**	**Standard.D**	**Variance**
0.00125412	0.089806	0.00802561	0.00068659	0.0897456	0.007987	0.00282896	0.0895928	0.007989
0.00224999	0.0897865	0.0080299	0.0019318	0.0897499	0.008019	0.00341361	0.0896327	0.008018
0.00164282	0.0897997	0.00802435	0.00193931	0.0897562	0.008027	0.00348476	0.0896542	0.008018
0.00172607	0.0897981	0.00803095	0.0020681	0.0897608	0.00803	0.00365066	0.0896592	0.008031
0.00167344	0.0897991	0.00802756	0.00235179	0.089779	0.008048	0.00423595	0.0896947	0.008036
0.00300133	0.0897645	0.00802883	0.00250954	0.0897796	0.008051	0.00425992	0.0896977	0.008036
0.00438094	0.0897078	0.00802589	0.00253273	0.0897839	0.008052	0.00458293	0.0897136	0.008047
0.00146406	0.0898028	0.00803316	0.0031107	0.0897909	0.008052	0.00464175	0.0897148	0.00805
0.0028178	0.0897705	0.00803582	0.0032427	0.0897938	0.008056	0.00528247	0.0897405	0.008054
0.00122761	0.0898063	0.00803054	0.00341193	0.0897939	0.008063	0.00536637	0.0897471	0.008057

Results

Figures-2 (a, b) showed the variability of the means and standard deviations of the considered patients. Obviously, tissues of normal and benign brain tumor have approximately the same ability to react to MR waves, whereas tissues of malignant brain tumor have remarkably higher ability to react to MR waves.



(A)



(B)

Figure 2(A, B)- The variability of the means and standard deviations of images.

One-Way Analysis of Variance
Analysis of Variance for Means

Source	DF	SS	MS	F	P
C4	2	0.0000309	0.0000154	25.55	0.000
Error	27	0.0000163	0.0000006		
Total	29	0.0000472			

Individual 95% CIs For Mean
Based on Pooled StDev

Level	N	Mean	StDev	--------+---------+---------+--------
Normal	10	1.79E-03	6.98E-04	(----*----)
Benign	10	2.38E-03	7.99E-04	(----*----)

Malignant 10 4.17E-03 8.29E-04 (----*----)
--------+---------+---------+--------
Pooled StDev = 7.77E-04 0.0020 0.0030 0.0040

Analysis of Variance for Standad deviation

Source	DF	SS	MS	F	P
C4	2	0.0000001	0.0000000	23.22	0.000
Error	27	0.0000000	0.0000000		
Total	29	0.0000001			

Individual 95% CIs For Mean
Based on Pooled StDev

Level	N	Mean	StDev	-----+---------+---------+---------+-
Normal	10	8.98E-02	3.00E-05	(-----*-----)
Benign	10	8.98E-02	1.86E-05	(----*-----)
Malignant	10	8.97E-02	4.92E-05	(----*-----)

-----+---------+---------+---------+-
Pooled StDev = 3.49E-05 0.089680 0.089720 0.089760 0.089800

Analysis of Variance for Coefficient of variation

Source	DF	SS	MS	F	P
C4	2	6412	3206	6.51	0.005
Error	27	13288	492		
Total	29	19700			

Individual 95% CIs For Mean
Based on Pooled StDev

Level	N	Mean	StDev	-------+---------+---------+---------
Normal	10	57.43	22.64	(------*------)
Benign	10	45.91	30.69	(------*------)
Malignant	10	22.31	4.70	(------*------)

-------+---------+---------+---------
Pooled StDev = 22.18 20 40 60

Means pixel intensities are significantly different for all three types of images as the F-test found to be equal to 25.55 with p-value less than 0.0001. The means of standard deviations and coefficients of variation showed that pixel intensities from normal and benign tumors images are almost have the same behavior whereas they were significantly different from images of malignant brain tumors with F-tests equal to 23.22 and 6.51 respectively with corresponding p-values of 0.00001 and 0.005 respectively.

The previous methods of distinguishing medical images, which include medical image classification, include the analysis of images and their analysis, and then inserting them into multiple calculations to obtain differences between images. The images are distinguished based on the clear aggregation of the number of pixels in the specified area and comparison Between them and the natural images of this aspect [14, 15].

The accuracy obtained in comparison with this method is close, but this method is so easy that any of the workers on the system can display images can approximate even though approximate images in terms of statistical information obtained through this program.

The ratio of the differences shown by the results means the numbers and the previous methods are concerned with the images . This comparison is done by different accuracy.

Conclusions

Brain tumors are an issue that have been paid great attentions according to its essential role on human lives. Brain tissue from biological point of view is very soft and that make it very sensitive to any source of infection or inflammation that could lead gradually to severe brain damages. Medically most of brain damages are irreversible, and hence care must be paid whenever it is needed. Early diagnosis of brain tumors may help avoiding critical problems later on.

Tissue from benign brain tumors although it is not significantly different from that of normal brain tissue, but still indicate the fact that such tissue may develop malignancy if not handled carefully.
The results showed that the three types of images are normal, benign and malignant. The differences between the three types are distinguished by the statistical information obtained from the images.

Diagnosis of the doctor deliberately to see the theoretical comparison between images in the memory of the memory stored in the brain, which may have a certain error rate, the intensity of light in one pixel and the comparison between them and the images give greater accuracy and thus can be used these processes that do not complicate complex to ascertain the validity of the diagnosis in addition to possible consideration of the condition of the patient in terms of response to treatment compared to the statistical information for the pre- and after taking the therapeutic dose.

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