Identification the Best Histogram Techniques for Brain MRI Image Enhancement Depend on Different Quality Matrices

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ABSTRACT

Image enhancement transform image to provide better representation of the subtle details and tool for researchers in wide variety field like MRI brain images .In this paper we use real MRI (which are taken from MadinatAltab hospital with 256 gray level) of Brain. This paper presents different techniques with their conceptual details are reviewed .using histogram to enhancement image (Equalization (two kinds which are global and local). Sliding, Stretching, Shrinking) that improve the visual quality of MRI brain images. In this paper, we compared different techniques implementation effect of techniques using histogram using image quality parameters (MSR, PSNR, SC, AD, NK and MD) are measure. From the experimental result, Histogram sliding was better than the other. This work is done using MATHLAB software.

Keywords: medical image, image enhancement, histogram equalization, histogram sliding, histogram stretching, histogram shrinking. Image quality

تحديد افضل تقنيات المنحي التكراري المستعملة لتحسين صور الرنين المغناطيسي للدماغ بالاعتماد على مقاييس جودة مختلفة

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المستخلص

تحسين الصور يستعمل ليقدم افضل تمثيل للتفاصيل وهو اداة للباحثين في مجال واسع ومتنوع مثل صور الدماغ MRIفي هذا البحث تم استخدام صور حقيقية اخذت من مستشفى مدينة الطب (ذات 256 مستوي رمادي).هذا البحث قدم تقنيات مختلفة لتحسين الصور مع تفاصيلها كلها تستخدام المخطط التكراري (تسوية (نوعان المحلي والمحور)،ازاحة ،توسيع)والتي تحسن الجودة المرئية لصور الدماغ MRI .وتم مقارنة تاثير تنفيذ التقنيات المختلفة المستخدمة لمنحني التكراري للصورة باستخدام معاير جودة الصورة المقاسة(,MSR PSNR, SC AD, NK and MD)النتائج العملية بينت ان تقنية ازاحة المخطط التكراري هي الافضل .تم استخدام لغة   MATHLAB software

1-Introduction

Image processing is a vast and demanding area and its applications used in various fields like medical images, satellite images and also in industrial applications [1]. Vision is the most advanced of our senses; images play the single most important role in human perception [2]. In Medicine Digital Image Processing techniques are used to enhance the contrast for easier interpretation of Magnetic resonance imaging (MRI) of the brain is a secure and effortless test that uses a magnetic field and radio waves to generate in depth images of the brain and the brain stem. MRI imaging is moreover used when treating brain tumors, bleeding and swelling etc. These high-resolution images, used to obtain complete anatomical information to observe human

brain maturity and discover abnormalities [3].The growth of advanced technology allows medical images to be captured stored and transmitted from one device to another with ease. During these processes, imaging systems may add some distortion, degradation or artifacts to images. Recent advances in multimedia technology dramatically reveal an increasing demand for quality controlled images [4].Image quality, for scientific and medical purposes, can be defined in terms of how well desired information can be extracted from the image .An image is satisfactory usefulness, which means discriminability of image content, and satisfactory naturalness which means identifiability of image content [5].Recently ,medical image application play an important role in our lives .In practical application , medical images undergo different types of processing including acquisition ,transmission or compression, which often generate some annoying distortion [6,7].Image enhancement is basically improving the interpretability or perception of information in image processing techniques [1].Original MRI images are generally having low contrast. It is difficult for doctors to analyses them. By increasing the contrast of an image, it will be easy for analyzing because of detailed information. This increase in contrast can be done by number of ways in image processing. Compares different methods of enhancement of brain MRI using histogram based techniques [8].Histogram equalization is one of the important steps in image enhancement technique for MRI.

Compares different methods like Brightness Preserving Bi-Histogram Equalization (BPBHE), Recursive Mean Separated Histogram Equalization (RMSHE), Brightness Preserving Dynamic Histogram Equalization (BPDHE), Dualistic Sub-Image Histogram Equalization (DSIHE), Minimum Mean Brightness Error Bi-HE Method (MMBEBHE), using different objective quality metrics for MRI brain image Enhancement [9].A histogram is the estimation of the probability distribution of a particular type of data. An image histogram is a type of histogram which offers a graphical representation of the tonal distribution of the gray values in a digital image. By viewing the image's histogram, we can enhancement of appearance of the different gray levels contained in the MRI and compared different techniques implementation effect using image quality parameters.

2. Magnetic Resonance Imaging (MRI)

Magnetic Resonance Imaging (MRI) uses powerful magnets and radio waves to produce detailed images of the body .The human body is mostly water, which contains hydrogen atoms. The magnet in an MRI machine produces a strong magnetic field that interacts with the hydrogen atoms. A combination of the magnetic and different radio frequencies makes possible for a specialized computer to generate an image MRI. is useful for structure and function of the brain ,heart and liver, soft tissues and the inside of bones It is also of cased to diagnose form of cancer, brain

diseases ,and conditions[10,11]. A magnetic resonance imaging instrument (MRI scanner), or "nuclear magnetic resonance (NMR) imaging" scanner as it was originally known, uses powerful magnets to polarize and excite hydrogen nuclei (i.e. single protons) of water molecules in human tissue, producing a detectable signal which is spatially encoded, resulting in images of the body. The MRI machine emits a radio frequency (RF) pulse at the resonant frequency of the hydrogen atoms on water molecules. Radio frequency antennas ("RF coils") send the pulse to the area of the body to be examined. The RF pulse is absorbed by protons, causing their direction with respect to the primary magnetic field to change. When the RF pulse is turned off, the protons "relax" back to alignment with the primary magnet and emit radio-waves in the process. This radio-frequency emission from the hydrogen-atoms on water is what is detected and reconstructed into an image. The resonant frequency of a spinning magnetic dipole (of which protons are one example) is called the Larmor frequency and is determined by the strength of the main magnetic field and the chemical environment of the nuclei of interest. MRI uses three electromagnetic fields: a very strong (typically 1.5 to 3 teslas) static magnetic field to polarize the hydrogen nuclei, called the primary field; gradient fields that can be modified to vary in space and time (on the order of 1 kHz) for spatial encoding, often simply called gradients; and a spatially homogeneous radio-frequency (RF) field for manipulation of the

hydrogen nuclei to produce measurable signals, collected through an RF antenna[12].fig(1)show an MRI machine and sample of MRI of brain
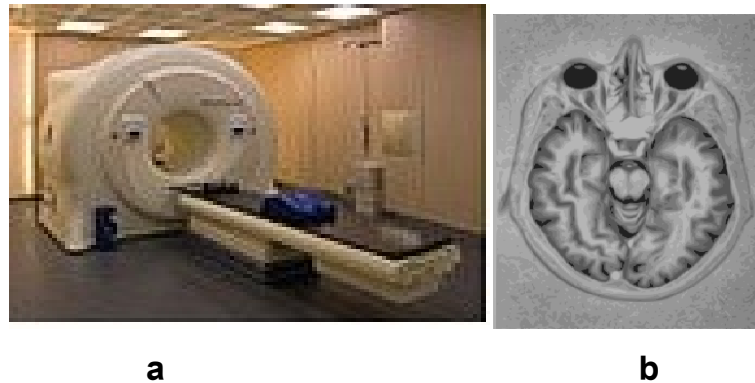

a   b

Fig (1): a-an MRI machine generates a magnetic field around patient

b-a brain MRI representation [12]

MRI imaging is also used when treating brain tumor, ankle and foot. From these high-resolution images, we can derive detailed anatomical information to examine human brain development and discover abnormalities. MRI consists of T1 weighted, T2 weighted and PD(Proton Density) weighted images [12].To give proper diagnosis and good results, doctors are provided with the different results of enhanced images.

3-Image enhancement

Enhancement is a fundamental task in digital image processing and analysis, aiming to improve the appearance of image in terms of human brightness perception [13].Image enhancement involves techniques to accentuate or sharpen the image features such as edges, boundaries or contrast to make a graphic display

more useful for display and analysis. Such images with good contrast and visual quality are required for all important areas of image processing .The inherent information content is not increased by applying enhancement techniques but there is an increase in the dynamic range of chosen factors. Enhancement is the alteration of an image to correct impact on the observer. The conditioning of the image can be passed out by preprocessing techniques is image enhancement. Image Enhancement techniques are used to develop the image excellence or appearance for human perception. The processed image is more fitting than the original image for a specific application [14].

3.1. Histogram Enhancement Methods.

Histogram provide an easy ,practical and straightforward way of evaluating image attributes, such as overall contrast and average brightness it can be used whenever a statistical representation of gray level in an image and histogram can also be used to enhance or modify the characteristics of an image , particularly its contrast. Some of these techniques, generally called histogram modification techniques instable (1) all kinds of histogram enhancement using and description of each one.

Table (1) the kinds of histogram enhancement using description of each one [15]

Kind of histogram enhancement	Description of histogram enhancement Technique
Histogram Equalization (there are two kinds which are global and local.	The gray level of the image is changed in such a way as to obtain a uniform resulting histogram in which the percentage of pixels of every gray level is the same
Histogram Sliding	This technique consist of simple adding or subtracting constant brightness value to all pixels in the image
Histogram Stretching	This technique consist of a linear transformation that expands (stretches) part of the original histogram so that its nonzero intensity rang occupies the full dynamic gray scale.
Histogram Shrinking	This technique modified the original histogram in such a way as to compress its dynamic grayscale range into a narrower gray scale the resulting image contrast is reduced [16].

4 -Image Quality

Image quality Measurement is vital in the development of image processing such as enhancement, deblurring, denoising etc. as it can be used to evaluate their performances in terms of quality of processed image [16].

1-Mean Square Error (MSR)

The MSR is defined as:

Error (MSE) is defined as:–

$$MSR = \frac{1}{MN} \sum_{i=1}^{M} \sum_{j=0}^{N} [X(x,y) - Y(x,y)]^2 - - - -(1)$$

2–PSNR (Peak Signal to Noise Ratio)

$$PSNR = 10\log \frac{255^2}{MSR} - - - - - - (2)$$

3–Structural Content (SC)

$$SC = \frac{\sum_{i=1}^{M} \sum_{j=1}^{N} (x(i,j))^2}{\sum_{i=1}^{M} \sum_{j=1}^{N} (X^\wedge(i,j))^2} - - - - - - - - - (3)$$

4– Average Difference (AD)

This measure show the average difference between the pixel values

$$AD = \frac{1}{MN} \sum_{i=1}^{M} \sum_{j=1}^{N} (X(i,j) - Y(i,j)) - - - - - - - - (4)$$

5–Normalized cross–correlation (NK)

$$NK = \frac{\sum_{i=1}^{M} \sum_{j=1}^{N} (X(i,j) * Y(i,j))}{\sum_{i=1}^{M} \sum_{i=1}^{N} (X(i,j))^2} - - - - - - - - (5)$$

6–Maximum Difference (MD)

$$MD = MAX| X(i,j) - Y(i,j)| - - - - - - - - - - -(6)$$

Where M X N is size of original image; X(i, *j*) and Y (i, *j*) are the original image and enhanced Image respectively [16].

5. Proposed Methodology

The proposed methodology can be divided into five steps.

Step 1: input image from MRI Brain slices (gray level and bitmap image format).

Step 2: image crop to remove the unwanted portions from the input image like personal information of patients.

Step 3: Get image histogram.

Step 4: Apply image enhancement using different kinds of histogram enhancements contain the following type and display the results

  a. Histogram equalization (two kinds which are global local).
  b. Histogram sliding.
  c. Histogram stretching.
  d. Histogram shrinking.

Step 5: six of image quality measurements se to compare the various image enhancement techniques which are (MSR, PSNR, SC, AD, NK and MD)

6-Results and Discussion

This work uses MRI Brain slices (which are taken from MadinatALtab hospital) done by using math lab software. Fig. (2) and fig. (3)Show the results of applying different kind of histogram enhancement techniques on slices of MRI Brain images such as (Equalization, Sliding, Stretching, and Shrinking)
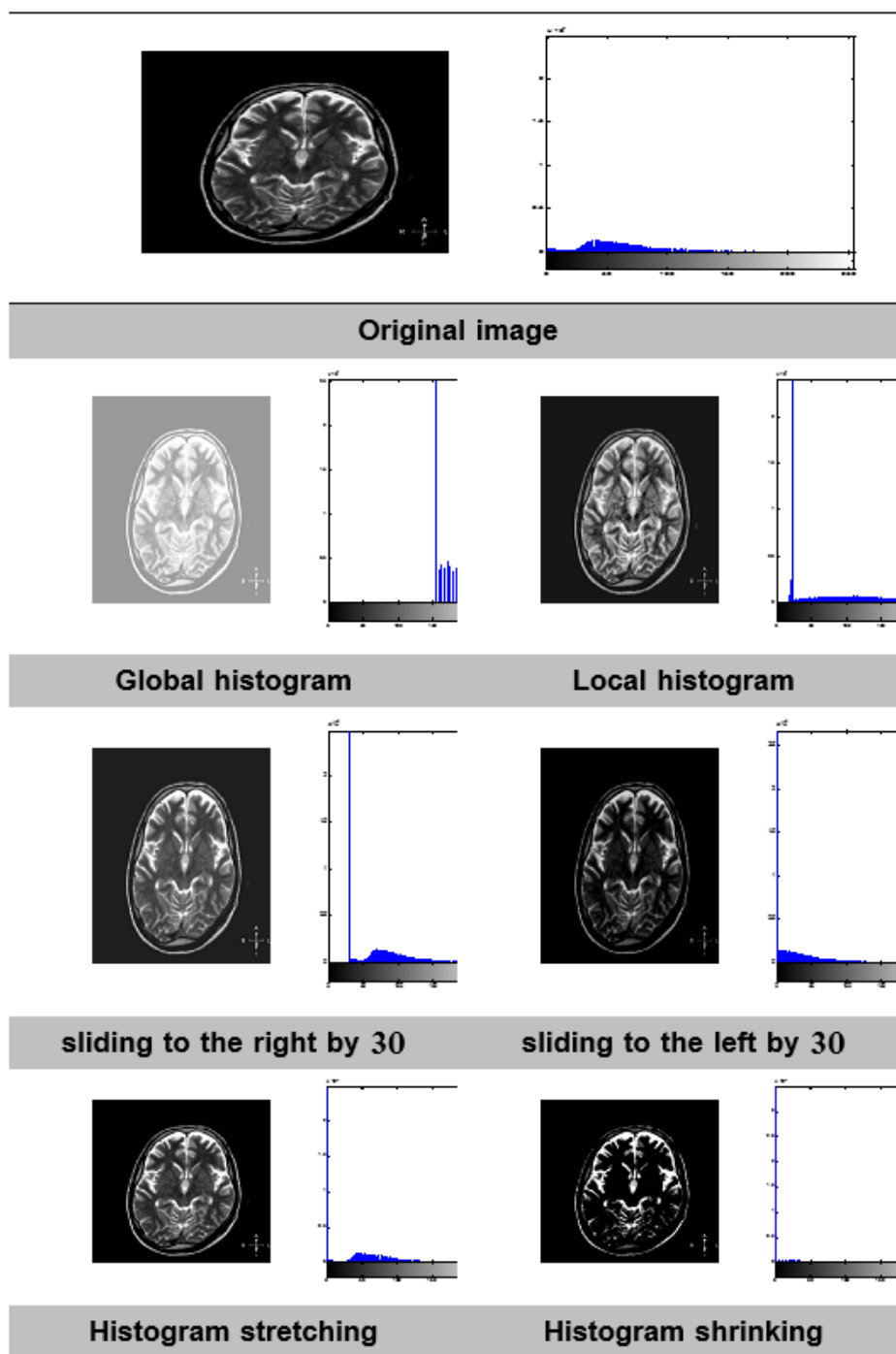
Figure (2):- Histogram enhancement result of MRI slices image1and
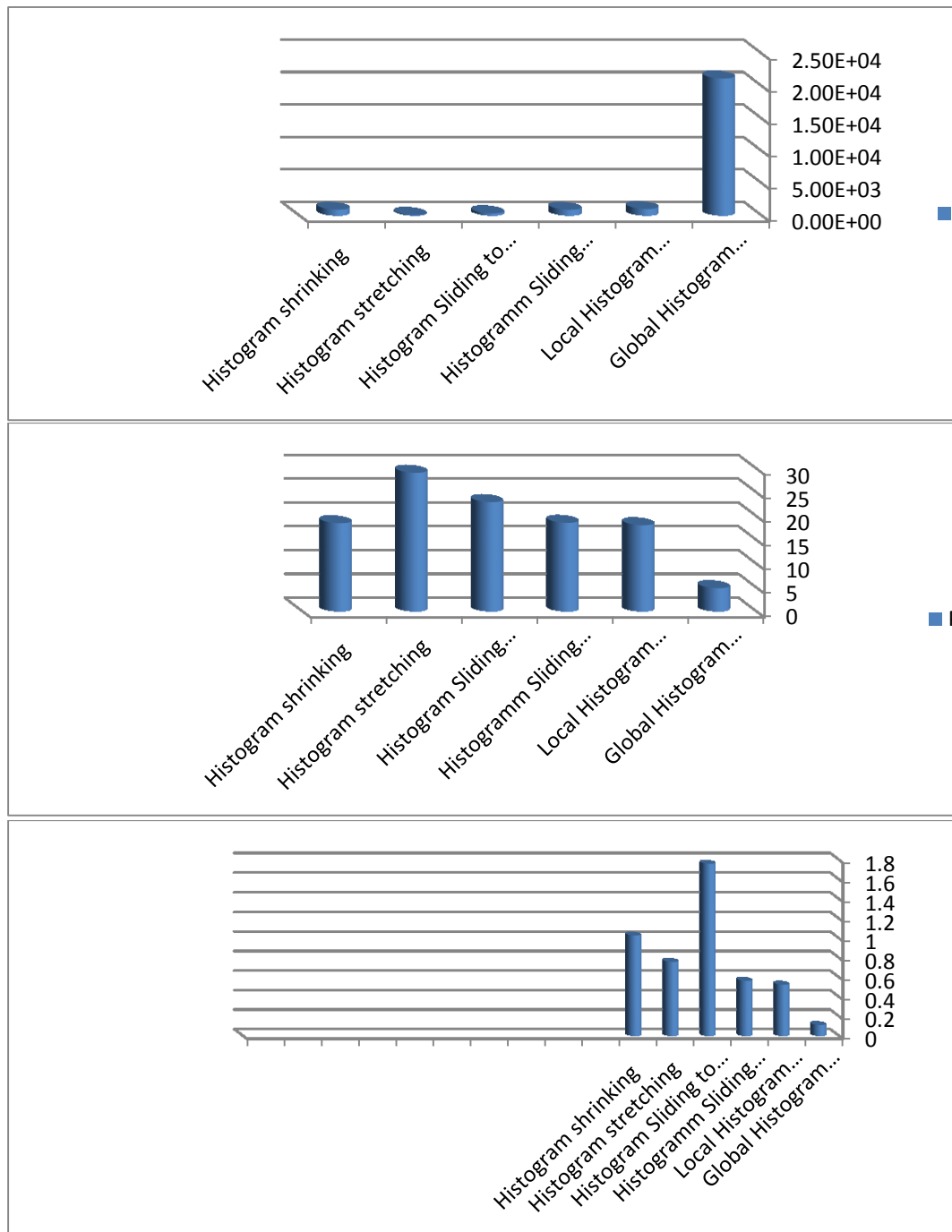
corresponding histogram

Fig (3):- the MSE, PSNR, &SC image quality parameters obtained by applying deferent types of histogram image enhancement for image1.
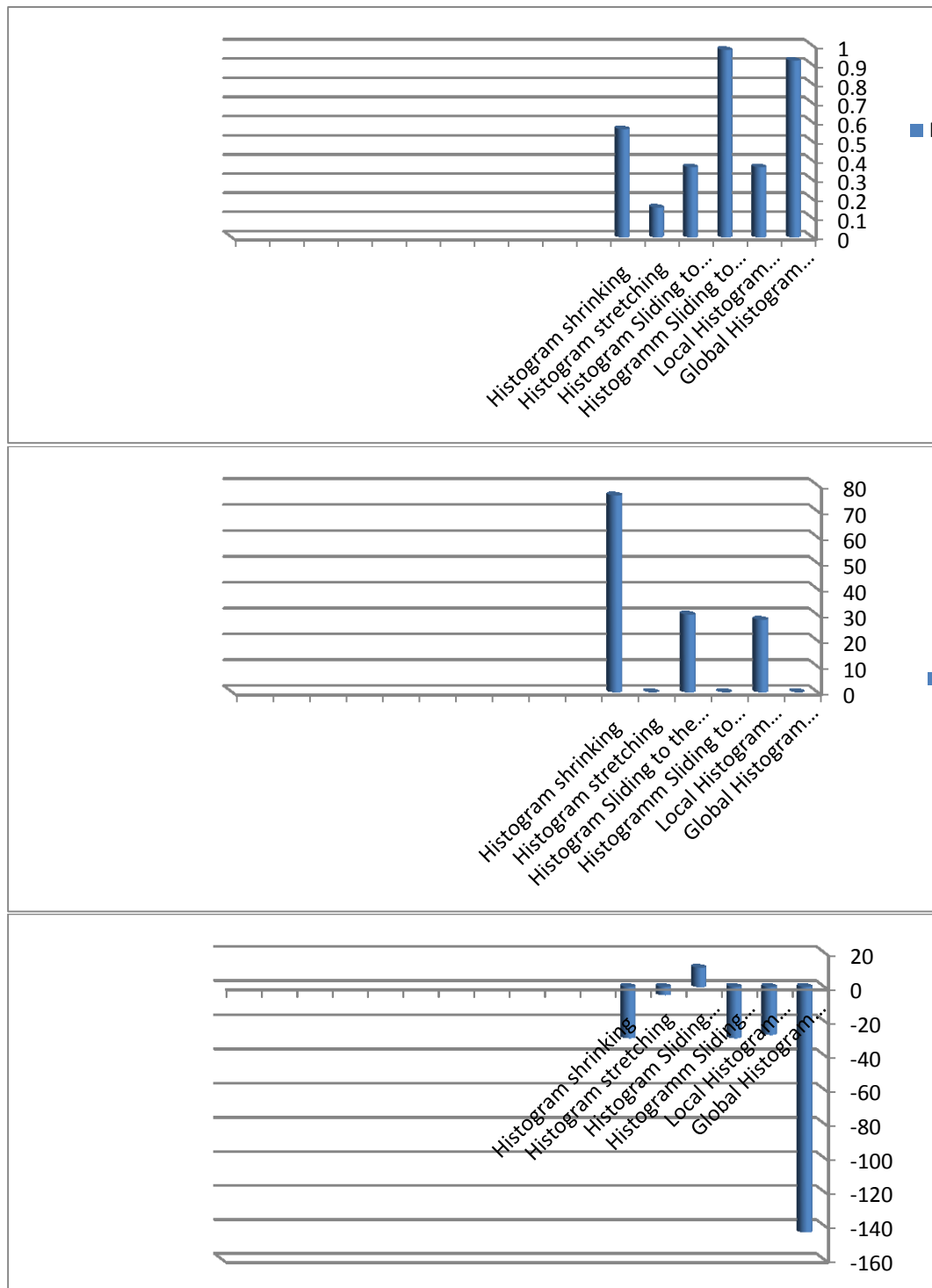
Fig (5):- the NK, MD& AD image quality parameters obtained by applying deferent types of histogram image enhancement for image1.
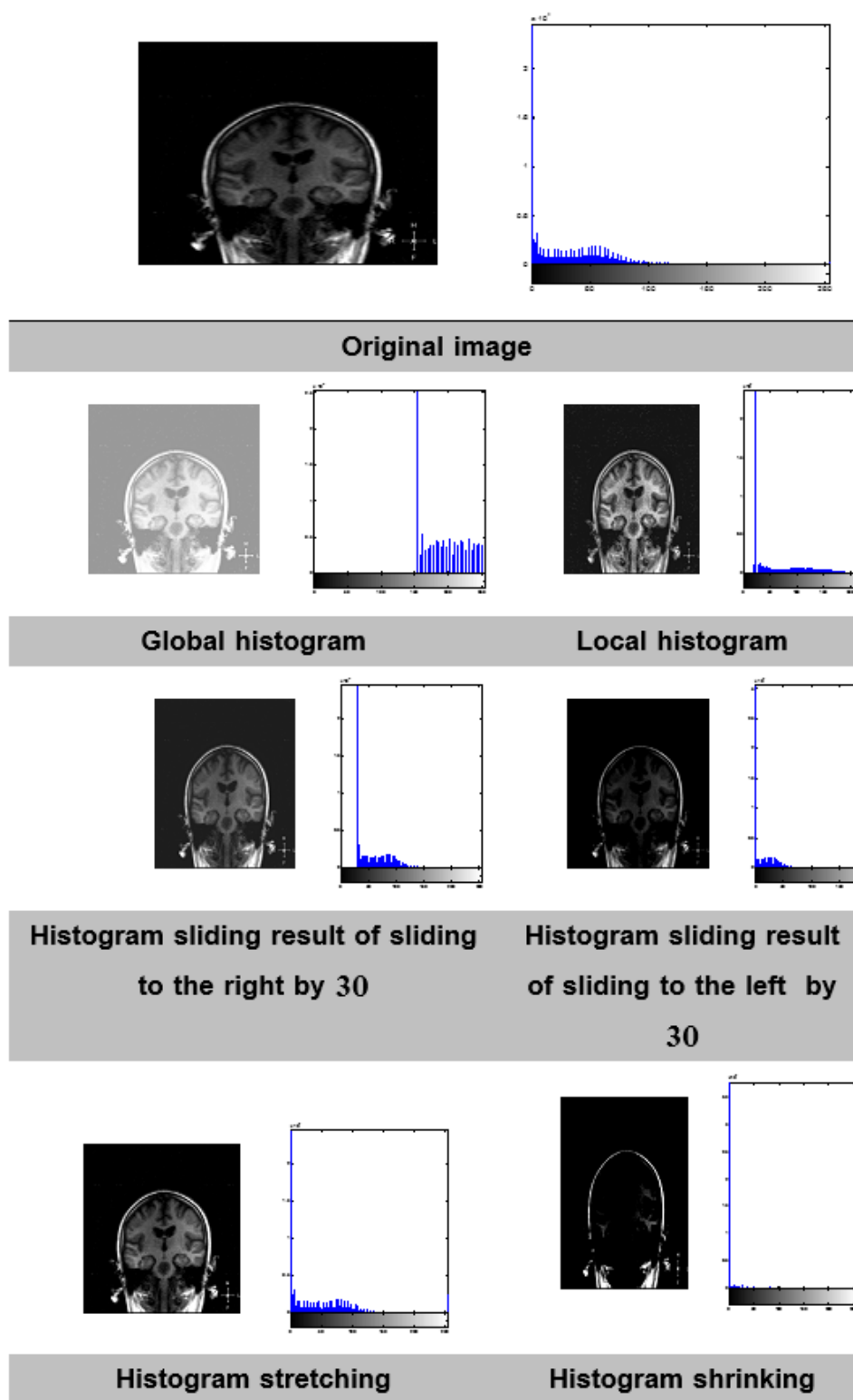
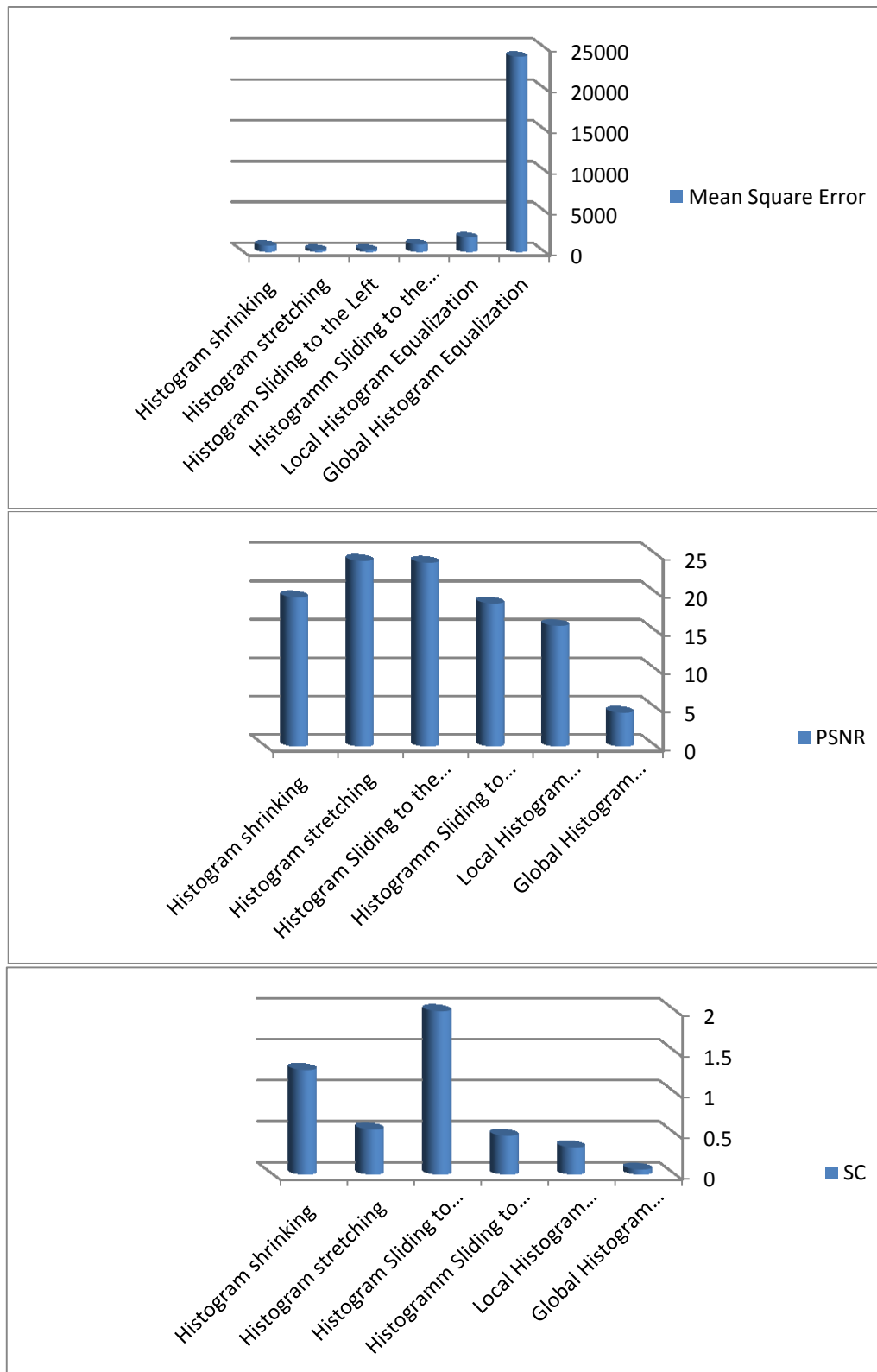**Figure (6):-** **Histogram enhancement result of MRI slices image2 and corresponding histogram**

Fig (7):‐ the MSE, PSNR, & SC image quality parameters obtained by applying deferent types of histogram image enhancement for image2.
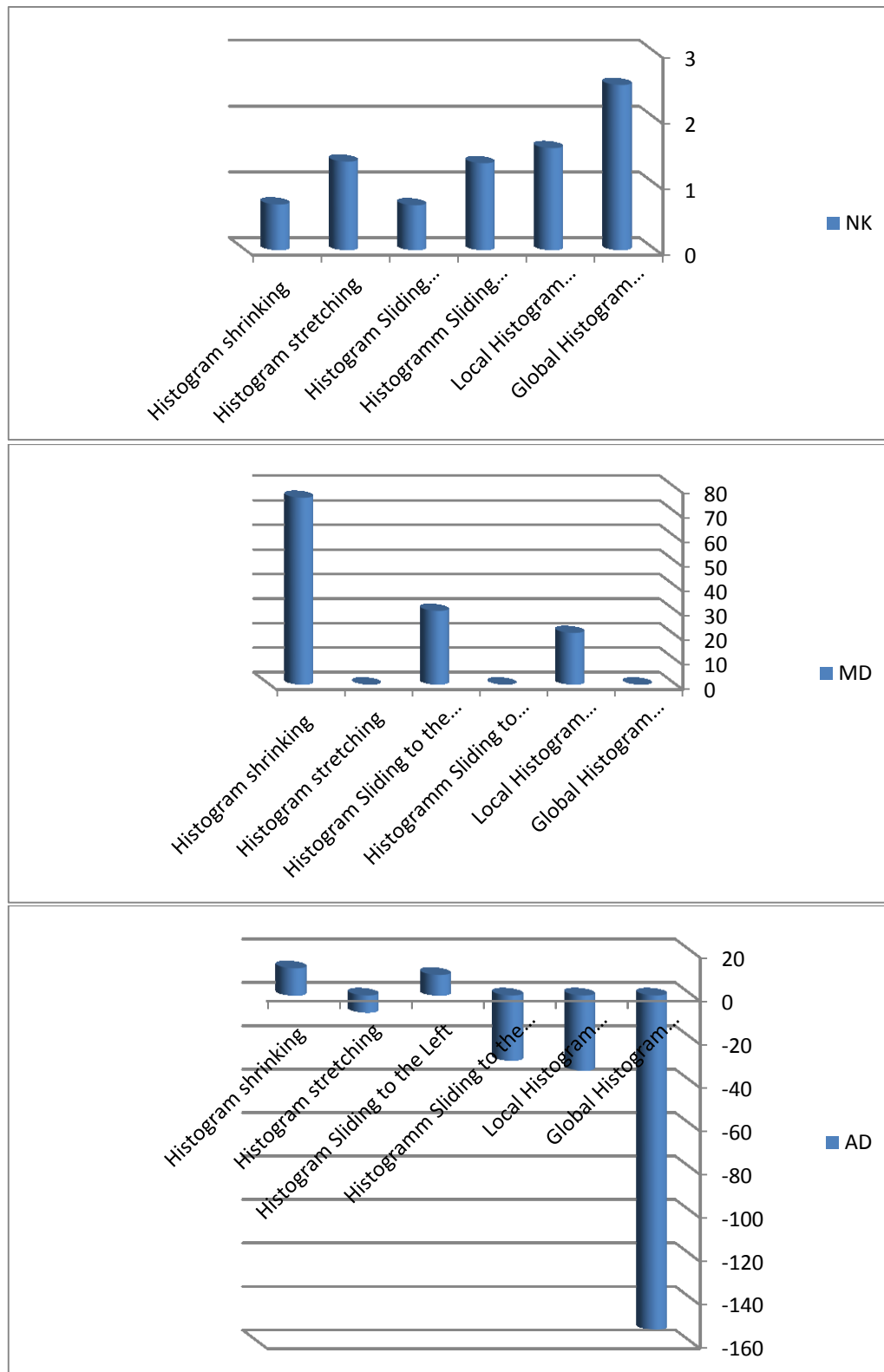
Fig (9):– the NK, MD, & AD, image quality parameters obtained by applying deferent types of histogram image enhancement for image2.

7-Conclusion

In this paper, we present histogram based approach for enhancement. The good image is useful for detail analysis and diagnosis and histogram in image-processing technique often used to achieve better quality images in black and white scales in medical applications such as MRIs Scans. All these images require high definition and contrast to determine the pathology that is being observed and reach a diagnosis. We achieve through the quality to evaluate the methods, we have used the (AD, MD, SC, PSNR, and RMS) as parameters. These parameters show that how the results vary on applying different techniques of histogram enhancement. It can perform good contrast enhancement methods for MRI Brain Image.

The output results have been analyzed for comparison of various quality metrics .these result shows

1-only a subset of quality metrics (which is AD, MD, SC, PSNR, and RMS) suited for quality metrics for MRI Brain and other metrics are simple change.

2–Thesliding to left Histogram enhancement is high

performance and provide approximation quality measurement.

References

[1] Pratik Vinayak Oak, Prof.Mrs.R.S.Kamathe" Contrast Enhancement of brain MRI images using histogram basedtechniques", International journal of innovative research in electrical, electronics, instrumentation and controlengineering, 2013.

[2] Annadurai s, Shanmugalakshmi R, Fundamentals of Digital Image Processing, 2007.

[3] http://kidshealth.org/parent/system/medical/mri_brain.html.

[4]S.Kayaa, M.Milanovaa, J.Talburta, B.Tsoub, M.Altynovac,"subjective Image Quality Prediction based on Neural Net work, "proceeding of 16th International Conference on Information Quality 2011.

[5]D.Gadkari"Image Quality Analysis Using GLCM,"MSC.Thesis in Modeling and simulation, university of central Florida, 2004.

[6] D.Osborne, D.Abbott, M.Sorell, andD.Rogers"Multiple Embedding using Robust Watermarks for wireless Medical Image,"College.Park, Maryland, USA, published in ACM, 2004.

[7] M.Lauckner. "Manual of diagnostic ultrasound"2"Edition, World Health Organization, 2011.

[8] RafaclC.Gonzalez, Richard E.Woods,"Digtal Image Processing", 2nd edition, pretice Hall, 2002.

[9]N Senthilkumaran1 and J Thimmiaraja2 A Study on Histogram Equalization for MRI BrainImageEnhancementAssociation of Computer Electronics and Electrical Engineers, 2014

[10]"Students, Material: Medical Imaging-The Glass Patient", Available online: http://www.fisme.science.uu.nl.

[11]G.Carneal,"Leaders in Imaging Quality: Safety and Education,"Issue1, 2013, Available online: www.radsitequality.com.

[12] WellP.N.T."Medical ultrasound imaging of soft tissue strain and elasticity"joumal of the Royal Society, Interface 8(64):1521-1546, 2011.

[13]Suimaya,ZenaVatsa."MRI image Enhancement"Interation Journal of Science and Research (IJSR)ISSN(on line):2319-7064,2013.

[15]R.C.Gonzalez and R.E.Woods.Digital Image Processing,3rdedition,PrenticeHall,Upper Saddle River, NJ,2008.

[16]R.C.Gonzalez,R.E.Woods,andS.L.Eddins.Digital Image Processing Using MATLAB,Pearson Prentice Hall,2004.

[17] RatchakitSakuldee and SomkaitUdomhunsakul,"Objective performance of Compressed Image Quality Assessments",Intemational Journal of Electrical and Computer Engineering,vol.2,no.4,pp.258-267,2007.