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Implementation of Contrast Stretching Algorithm on Lung Cancer Effected Images for Analysis

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***Abstract* ---- Lung cancer is the uncontrolled growth of abnormal cells in the lung. Normal lung tissue is made up of cells that are programmed by genes to create lung tissue in a certain shape and to perform certain functions lung cancer develops when the genetic material which is responsible for production of lung cells is damaged called genetic mutations.**

This paper represents a computer assisted diagnosis system of lung cancer that demonstrates spreading of tumors and damage of lungs if the patient neglects it. This work is based on one of the image processing techniques called image enhancement involving Contrast stretching algorithm. The local and global contrast stretching techniques are used to find better solution. The results obtained and the statistical analysis demonstrates the distribution of tumors over lungs and educate the patients towards precaution and medication. The statistical values are calculated using MIPAV software .

Keywords- lung cancer; Computer Aided Diagnosis; Histogram; Image Intensity; Image contrast; Image Enhancement.

I. INTRODUCTION

The ultimate aim in a large number of **image processing** applications is to extract important features from the image data, from which a description, interpretation, or understanding of the scene can be obtained for human viewers, or to provide `better' input for other automated image processing techniques.

Lung cancer is known as one of the most difficult cancers to cure and the number of deaths that it causes is generally increasing. A detection of the lung cancer in its early stage can be helpful for medical treatment to limit the danger [1]. One of the measures is a mass screening process for lung cancer. As a conventional method for mass screening process, chest X-ray films have been used for lung cancer diagnosis.

To date several research groups have focused on the development of computerized systems that can analyze different types of medical images and extract useful information for the medical professionals. **Computer Aided Diagnosis** (CAD) has been proposed for and used in many areas involving repetitive analysis of medical images [2]. Notably, a radiologist may often have to evaluate hundreds of images every day. The result: fatigue that can cause mistakes in diagnosis. Computers can be invaluable as "second readers" that analyzes digitized form of the images, following rules similar to those that would normally guide a radiologist[3]. Additionally, CAD can help to reduce the cost and time for the radiologist. The image processing techniques are not only used for early detection of lung cancer from X-ray images and also to forecasting the distribution of tumors over lungs from early stage to fully damaged state. This paper presents the conditions of lungs when they fully affected by cancer using image enhancement technique called contrast stretching.

This paper is organized as follows. Section II reviews the brief review of the basic image enhancement techniques namely histogram processing and equalization. Section III introduces the methodology involved in this paper. Section IV presents the Experimental results for an X-ray image which shows the lungs affected by cancer and the paper is concluded in Section V.

II. IMAGE ENHANCEMENT TECHNIQUES

Enhancement is a fundamental task in digital image processing and analysis, which makes the appearance of image in terms of human brightness perception. Image enhancement techniques are designed to improve the quality of an image as perceived by a human being [11].

The principle objective of enhancement is a process of an image so that the result is more suitable than the original image for a specific application. **Image enhancement** process consists of a collection of techniques that seek to improve the visual appearance of an image or to convert the image suitable for analysis by a human or machine [6]. Meanwhile, the term image enhancement means the improvement of an image appearance by increasing dominance of same features or by decreasing ambiguity between different regions of an image [7].

A. Histogram processing:

Histograms are the basis for numerous spatial domain processing techniques. **Histogram** manipulation can be used effectively for image enhancement [4]. The histogram provides the useful image statistics and project the frequency distribution of image gray levels. Here the intensity levels distributed into a certain number of intervals. These levels are spread from 0 to 255 for gray scale images in which '0' corresponds to black and '1' corresponds to white. The intensity levels in between this range are the gray shades for an image [4].

B. Histogram equalization:

A perfect image is one which has equal number of pixels in all its gray levels. Hence to get a perfect image our objective is not only to spread the dynamic range but also to have equal pixels in all the gray levels. Histogram equalization provides a perfect image with uniform brightness [10]. It modifies the **intensity** levels and make them almost equal i.e. it makes the number of pixels per each intensity level is same. So that all the gray levels are equally distributed to entire image and clearly visible. It is a basic technique for better appearance of an image. It is not only providing clear image but also helps to modify the intensity levels for further analysis. The equalization makes the contrast to increase at the most populated range of brightness values of the histogram

III. CONTRAST STRETCHING TECHNIQUE

The Contrast enhancement is frequently referred to as one of the most important issues in image processing. Contrast is created by the difference in luminance reflected from two adjacent surfaces. In visual perception, contrast is determined by the difference in the color and brightness of an object with other objects. Our visual system is more sensitive to contrast than absolute luminance. The **contrast stretching** is the image enhancement technique that commonly used for medical images. To date, contrast stretching process plays an important role in enhancing the quality and contrast of medical images [8]. If the contrast of an image is highly concentrated on a specific range, the information may be lost in those areas which are excessively and uniformly concentrated. The low contrast images can result from poor illumination, lack of dynamic range in the imaging sensor or even wrong settings of a lens aperture during image acquisition. The idea behind contrast stretching is to increase the dynamic range of gray levels in the image being processed.

Global enhancement technique is simple and fast, but its contrast-enhancement power is relatively low. The histogram processing method is '**global**', in the sense that pixels are modified by a transformation function based on gray level content of an entire image. Although the global approach is suitable for overall enhancement, there are cases in which it is necessary to enhance details over small areas in an image. The number of pixels in these areas may have negligible influence on the computation of a global transformation whose shape does not necessarily guarantee the desired **local enhancement.** Local histogram equalization, on the other hand, can enhance overall contrast more effectively The solution is to devise transformation functions based on gray level distribution in the neighborhood of every pixel in the image.

The histogram processing techniques are easily adoptable to local enhancement [5]. The procedure is to define a square or rectangular neighborhood and move the center of this area from pixel to pixel. At each location, the histogram of the points in the neighborhood is computed and either a **histogram equalization** or histogram specification transformation function is obtained. The function is finally used to map the gray level of the pixel centered in the neighborhood. The center of the neighborhood region is then moved to an adjacent pixel location and the procedure is repeated. This approach has obvious over repeatedly computing the histogram over all pixels in the neighborhood region each time the region is moved one pixel location.

The sliding of the windows (KERNEL) can be performed by using the following formula

$$\mathbf{I_P(x,y) = 255\ [\ I_0(x,y) - Min] / (Max - Min)}$$

Where $I_P(x,y)$ is the gray level of output pixel (x,y) after the contrast stretching process, $I_0(x,y)$ is the gray level input for data pixel (x,y), *Min* and *Max* are the minimum & maximum values for gray level in the input image.

From the formula (x,y) are the coordinates of the center picture element in the sliding window (KERNEL) and *Min* and *Max* are the minimum , maximum values of the image data in the selected KERNEL [9].

IV. RESULTS

Here, the **local and global contrast stretching** image enhancement technique has been used to show the way the tumors are developed by varying the minimum intensity value.

The Fig.1 shows the actual lung area affected by cancer. Here affected area in LHS is not clearly visible because of the inequality of gray levels. The fig 2 shows the inequality of the gray levels for entire image with the help of its histogram. In the Fig.2, the X-axis shows the gray levels from 0 to 255. The '0' corresponds to black color and '255' corresponds to white color. The Y-axis shows the number of pixels in the image.

Fig. 1. Original image

Fig. 3. Normalized image

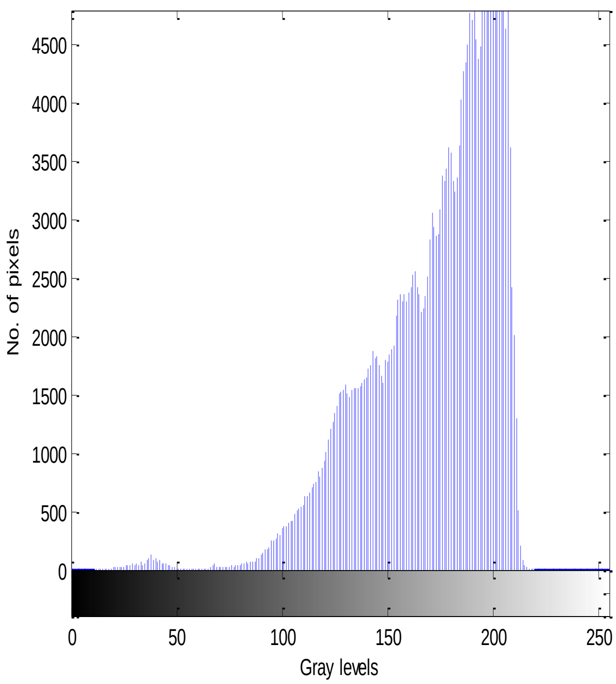

Fig. 2. Histogram of original image

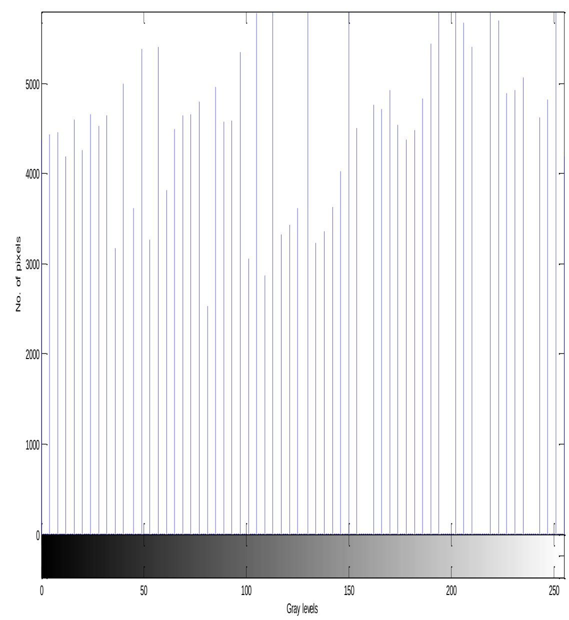

Fig. 4. Histogram of normalized image

The histogram equalization technique has been used to visualize the cancer affected area of lung clearly. The Fig 3 and 4 shows the resultant image and its equivalent histogram. The number of pixels for each gray level are brought to almost equal.

The original image is processed through proposed technique for different values of minimum intensity and obtained the results as shown in Fig 5.

The Fig 5(a) is obtained when the minimum, maximum gray levels are 225and 256 respectively. Since the affected area in LHS is shown as very less, this stage of cancer is said to be the starting stage. The development in cancer is demonstrated using the remaining figures. These results can be obtained by decreasing the minimum intensity level using the proposed technique.

Fig.5. Illustration of development of cancer using contrast stretching technique with *min* and *max* intensity levels.

Fig. 5(a). Min = 225, Max = 256

Fig. 5(b). Min = 205, Max = 256

Fig. 5(c). Min = 185, Max = 256

Fig. 5(d). Min = 175, Max = 256

Fig. 5(e). Min = 128, Max = 256

Fig. 5(f). Min = 100, Max = 256

The following table projects the statistical analysis for different VOIs specified in each image.

	Avg Voxel Intensity	Std Dev of Intensity	Variance	Sum Intensities	Eccentricity	Coefficient of skewness	Coefficient of kurtosis
VOI-1	2.107	20.9383	438.41	16527	0.716	11.6707	138.495
VOI-2	11.2786	50.4258	2542.76	115132	0.6516	4.5355	21.6482
VOI-3	32.375	82.8854	6869.98	380341	0.7385	2.2643	6.1442
VOI-4	46.6248	96.3731	9287.77	551898	0.7431	1.6562	3.7546
VOI-5	126.9541	125.3511	15742.89	1782308	0.6871	0.0089	1.005
VOI-6	189.628	109.3216	11951.21	2061825	0.7737	-1.1211	2.2642

- The Avg Voxel Intensity gives the mean value of the intensities present in the VOI. The increment in mean value gives information about growth of tumors over lungs.
- Sum intensity is the combined value of intensity that the VOI consists. In the results, this value shows the intensity of white color interns the area of cancer effected lung.
- The eccentricity is the ratio of the distance between the foci of the ellipse and its major axis length. The value is between 0 and 1.
- Coefficient of skewness: The information about the shape of a distribution using shape statistics can be provided with the help of Skewness. Skewness is a measure of symmetry, or more precisely, the lack of symmetry. A distribution, or data set, is symmetric if it looks the same to the left and right of the center point. Skewness is calculated by dividing the third central moment by the cube of the population standard deviation.
    - If Sk = 0, then the frequency distribution is normal and symmetrical.
    - If Sk is +ve, then the frequency distribution is positively skewed.
    - If Sk is -ve, then the frequency distribution is negatively skewed.
- Coefficient of kurtosis: kurtosis characterizes the relative peakedness or flatness of a distribution compared to the normal distribution. Positive kurtosis indicates a relatively peaked distribution. Negative kurtosis indicates a relatively flat distribution. **Kurtosis** is a parameter that describes the shape of a random variable's probability distribution.

V. CONCLUSIONS

Since, lung cancer is a disease of uncontrolled cell growth in tissues of the lung; this growth may lead to metastasis, which is the invasion of adjacent tissue and infiltration beyond the lungs**.** So it is essential to educate the people towards prevention of the lung cancer.

This paper presents a study to detect the tumors in and distribution of tumors over lungs. Here, image normalization has been used to identify the tumors and also the local & global contrast stretching technique has been used to show the growth of lung tumors. This work can be extended using mathematical morphology operations to separate the affected lung portion from full image and image segmentation methods to extract some useful information from image. Finally, a disadvantage of contrast enhancement technique used is that they can only be used satisfactorily in images with moderate lightning.

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REFERENCES

[1]. Radhika sivaramakrishna, J. Scott Birbeck, Brent E. Higgs, and Robrt M. cothren, "*Medical Computer-aided Detection of Lung cancer from Computed Tomography Images",* Technology review journal* Fall/ Winter 2002.

[2]. "*Computer Assisted Screening for Lung Cancer Based on Helical CT Images",* Mitsuru Kubo, Hitoshi Satoh, Hironobu Ohmatsu.

[3]. *"Computer Assisted Diagnosis of Lung Cancer Using Helical X-ray CT"* K.Kanazawa, N.Niki,H.Satoh ,H.Ohmatsu, N.Monya

[4]. "*Digital Image Processing"* by Rafael C. Gonzalez, Richard E. Woods -ADDISON-WESLEY. An imprint of Pearson Education

[5]. N.R.Mokhtar,Nor Hazlyna Harun, M.Y.Mashor, H.Roseline, Nazahah Mustafa, A.Adollah, H.Adilah, N.F.Mohd Nasir, "*Image Enhancement techniques using Local, Global, Bright, Dark and Partial Contrast stretching for Acute Lukemia Images",* proceeding of world congress on Engineering 2009 Vol 1- 2009, Lundon, U.K.

[6]. William k. pratt(2007), " *Digital Image Processing",* Los Altos, California.

[7]. Bhabatosh Chande and Dwijest Dutta Manjumder, 2002. "*Digital Image Processing and Analysis".*

[8]. Mat Isa, N.A.Mashor, M.Y & Othman, N.H. (2003). " *Contrast Enhancement Image Processing on Segmented Pap Smear Cytology Images",* Prof. of Int. Conf. on Robotic, Vison, Information and Signal Processing. 188-125.

[9]. Attas I. J.Belward, " *A variational approach to the radiometric enhancement of imagery",* IEEE Trans, Image Process, 4(6)(June 1995) 845-849.

[10]. Ali Ziaei, Hojatollah Yeganch, Karim Faez, Saman Sargolzaei, *" A Novel Approach for Contrast Enhancement In Biomedical Imges Based on Histogram Equalization"* 2008 International Conference on Bio Medical Engineering and Informatics, Vol, pp. 855-858, 27-30, May 2008.

[11]. Fahimuddin.Shaik, Dr.M.N.Giri Prasad, B.Abdul Rahim, A.SomaSekhar, *"Medical Image Analysis of Electron Micrographs in Diabetic Patients Using Contrast Enhancement"*, International Journal of algorithms, Computing & Mathematics Volume 3, November, 2010.