Morphological Cancer Cell Diagnosis: Applying Contemporary Method of Image Processing

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Morphological Cancer Cell Diagnosis: Applying Contemporary Method of Image Processing

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Abstract: In this monumental arena, extension of living species got a spike which is accompanied by an escalation of menacing diseases or flues. The velocity of cure hasn't reached that mark yet only for the reason that the disease inducing cell is not discerned at the antecedent phase. This inadequacy is yielding to a case that human life has to wrap up. Among all the diseases the most awaited cure is for cancer. In truth, there is cure for cancer which involves medical processes of chemotherapy and radiation. Besides, these processes work efficiently when the detection of cell behavior at initial phase. The present pathology methods require two days in least to diagnose cancer, it even adds up huge laboratory work [1]. All these instances come into the category of imperfection. The scope of this article is to furnish a solution for all these flaws by adopting the usual diagnosis procedure in addition, nomination of image processing aids the diagnosis process to a higher rate. This operate as usual digital image processing technique which take a reference image and an affected image or the morphological image collected by normal diagnosis machines whose difference is observed [2]. This method is different from usual techniques it creates a visualization of cell tissues which can be differentiated using normal one's. This adoption leads to accuracy, automation, quick analysis, less laboratory work and prior notice of effected cell in cancer diagnosis.

***Index terms* - Cancer diagnosis, Image processing, tissue morphology, python, cv2, numpy, fft, cancerous cell images, Normal cell image, thresholding, binary conversion, transformation, filtration.**

I. INTRODUCTION:

The familiar type of cancer is liver cancer; the scientific name is given as "Hepatic Cancer". The medical reasons behind this type of cancer are excessive alcohol consumption, cirrhosis, chronic infection, Diabetes, Exposure to alpha-toxins. The most common and known cause is excessive alcohol consumption. For men, it is stated as 5th most common cause for cancer death. It is approximated that around 30,200 deaths will occur this year due to this disease. But cancer can be treated if it was diagnosed at early stage. Among 43% of people who diagnosed at earlier stage has 5-year survival rate of 31%. In India, 71% of cancer affected patients died without getting diagnosed. The main cause is it is not detected at prior stage [3]. The fact is that if cancer tissue is detected at the earlier stage it can be cured with proper medication.
At present, the techniques used to process the cancer diagnosis are Blood tests, Imaging, Biopsy.

Among all these, Imaging tests are performed preliminarily to detect cancer. In the imaging tests pathologist is directed to make Magneto Resistance imaging or Ultrasound Imaging or Computerized tomography. By the reports given by the pathologist, doctor extracts the faults manually and draw the conclusion according to reference images. This process is little draggy and difficult task for doctor to analyze. So, to overcome this issue it's important to employ image processing techniques to analyze the data and to end up showing exact results. The main objective of this work is to provide accurate result, time minimization and automation of cancer diagnosis [4].

The better algorithms are adopted for efficient results; this technique would diagnose the pre-cancer where medication can be adopted to cure it. This modern approach utilizes the same existing techniques which incorporates for efficient results. This proposed work uses image processing using python on CT, MRI and Ultrasonic imaging reports. Image processing uses computer algorithm to perform analysis on those imaging reports. Which is automated to show up the result of cancer if it is detected.

II. METHODOLOGY

The contrivance made for this proposed work is followed by following pictogram.

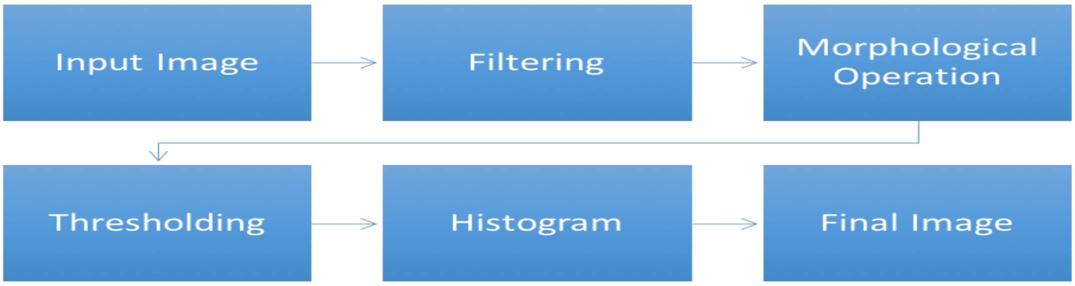

Fig (1): Flow chart of implementation

A. Median filtering:

In image handling, filters are mostly used to suppress the high frequencies in the image, i.e. smoothing the picture, or the low frequencies, i.e. improving or identifying edges in the picture.

The median filter is a nonlinear computerized filtering technique, frequently used to expel noise from a picture.

Such noise decreasing process is a regular pre-preparing venture to enhance the consequences of later handling. Median filter is generally utilized as a part of computerized image preparing on the grounds that, under specific conditions, it stores the edges of the image and having many applications in signals [5].

The principle of the median filter is to go through the pixel of image entry by entry, supplanting every entry with the median of neighborhood entries. The example of neighbors is known as the "window", which slides, section by passage, over the whole pixels of the image. For 2D (or higher-dimensional) images, for example, pictures, more unpredictable window designs are conceivable, (for example, "box" or "cross" examples). If the window has an odd number of sections, at that point the middle is easy to characterize and it is only the center an incentive after every one of the passages in the window are arranged numerically. So, the middle pixel or having high noise pixel can be replaced with any one of the windows(pixels). So, the noise of the image is completely removed. This filter is very highly efficient in removing salt and pepper noise. In this we have used 'cv2.medianblur()' function in python to perform the median filtering. The syntax of the function is 'cv2.medianblr(source_ image, blur_ value)' the first parameter of this is source image which may be of type source_image.png, source_image.jpeg, source_image.jpg and we have taken source image as MRI scanned image and the second parameter is blur_ value which refers the blurring of an image [6].

The median filtering of a cancer cell and healthy cell are shown in below figures.

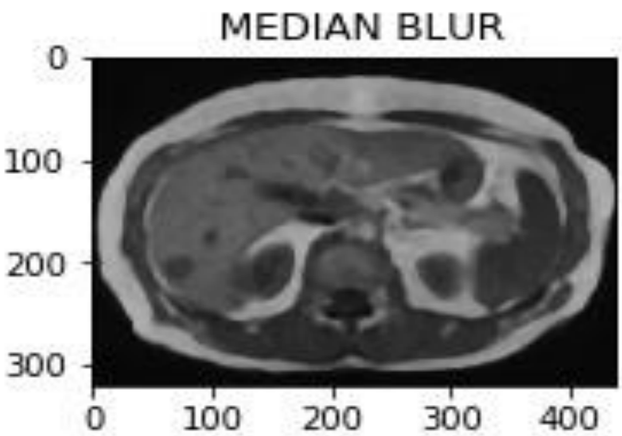

Fig (2): cancer cell

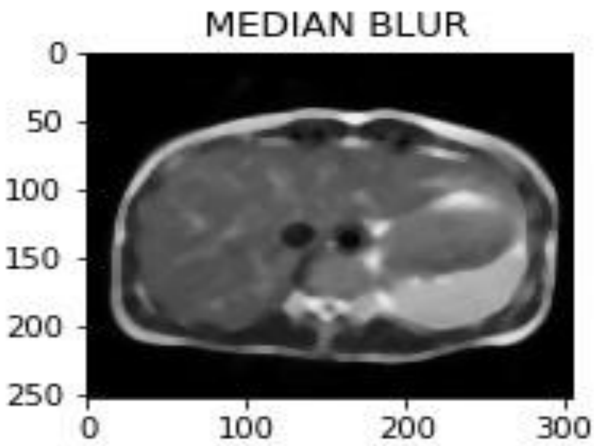

fig (3): healthy cell

As we look in the both the images the cancer cell much difference in visualization hence, we can employ median filter. The black spots in the cancer cell indicates that the cell has been damaged.

Closing: Morphology is an expansive arrangement of image processing tasks that process images based on shapes. Morphological tasks apply an organizing component to an input image, making an output image of a similar size. In a morphological task, the estimation of every pixel in the output image depends on an examination of the relating pixel in the input image with its neighbors. Closing is an essential technique in the field of morphology. It is like double administrator, it can be gotten from the operations like dilation and erosion. Like those administrators it is regularly applied to binary images, despite the fact that there are also applicable to gray level forms. closing is equivalent to dilation as it tends to build the limits of the forefront of info picture, yet it makes less harm the first picture limit. Similarly, as with other morphological administrators, the correct activity is dictated by an organizing component. The effect of the director is to ensure the foundation districts that have same shape to organizing component through wiping out every single other area of the foundation pixels [7]. The working of closing can be simply said as a dilation followed by erosion using the same input image for both operations.

B. Dilation:

Dilation is one of the two fundamental administrators in the morphology, the other being erosion. It is regularly applied to binary images, yet there are variants that work on grayscale images. The essential impact of the administrator on a binary image is to bit by bit broaden the limits of boundary of foreground area pixels [8]. The dilation administrator takes two bits of information as sources of info. The first is the image which is to be dilated. The second is an arrangement of facilitate focuses known as structuring element. It is this organizing component that decides the exact impact of the dilation on the input image.

C. Erosion:

Erosion is one of the two essential administrators in the morphology, the other being dilation. It is normally applied to binary image. The essential impact of the administrator on a binary image is to dissolve away the limits of foreground pixels [9].
We have done closing operation using 'cv2.dilate() and cv2.erode()' functions in python.
Erosion uses the function erode function and syntax as follows cv2.erode(source_ image, kernel, iterations) the first parameter of this syntax is source image which is the median filter image and second parameter is kernel is a structuring element which maintains the clarity of the image and the third parameter is iterations which describes about the number of times the erosion has to be applied. Like Erosion, Dilation also uses the function dilate and the syntax of the function as follows cv2.dilate(source_ image, kernel, iterations) like the erode function same the dilation parameters have its own functionality and here the first parameter refers input image and second parameter is kernel which is a structuring element refers to the quality of erosion and the final parameter is iteration and tells the number of times to dilation to be happened.

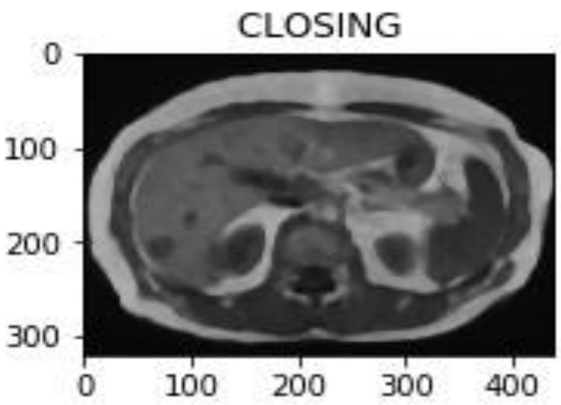

fig (4): cancer cell

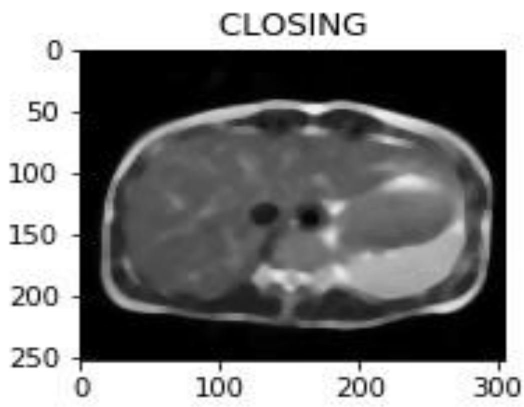

fig (5): healthy cell

D. Thresholding:

The Thresholding is the uncomplicated approach to image segmentation. It manipulates the Gray-Scale image to binary image here, binary refers to either black or white like 1 or 0 in Digital Logic Design. This section is divided into parts where each highlights the use and its operation. Use: It is used to eliminate Gray-Level variations in a picture. It is applied in the circumstances where the image has to be discrete (Sampling of original) and to 'segment' (process of splitting up an image into parts) an image. Operation: It operates as usual thresholding. The threshold value is set where the pixel value shouldn't cross, it naturally cites to mounting all the Gray-Levels subordinate to an undisputed value to zero; or over that value to an extreme brightness level. This will discard all the unfavorable trends in the Gray-Levels which are close, over or beyond the threshold value [10]. The module used to adopt thresholding is CV2 in python. The function used is cv2.threshold(), the syntax of the mentioned function is given as "cv2.threshold(gray_image, thresh_value, max_value, type)".
First parameter is the gray scale image of input image, second parameter is threshold value which is used to sample the image, third parameter is given as the maximum value of pixels it depends on the given image usually it is greater than the threshold value but sometimes it is less than threshold value. The fourth parameter gives the type of thresholding. The thresholding used here is simple thresholding [11]. The statement used in our proposed work is given as "th1 = cv2.threshold(closing,127,255,cv2.THRESH_BINARY)".
The variations obtained is shown in below figures.

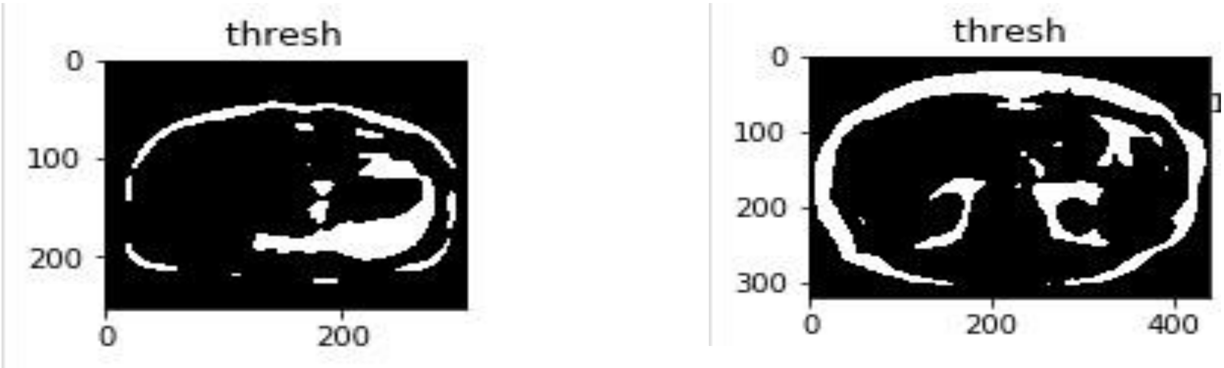

Fig (6): Threshold of non-cancerous (left) and cancerous (right)

E. Histogram:

An image Histogram is a kind of Histogram where the color tone of an image is depicted graphically. It outlines the quantity of pixels for each tonal esteem. By taking a gander at the histogram for a particular picture a watcher will have the capacity to judge the whole tonal appropriation initially. In simple way, we can define histogram as a graph or a plot. It gives the clear illustration regarding intensity distribution of the picture. The X- axis is taken as the pixel values ranging from 0 to 255 but not in all cases. The Y- axis is taken as the pixels of image which varies according to X- axis. Having a glance at histogram of an image one can illustrate brightness, contrast, frequency distribution etc. If pixels are high at that region histogram graph raises and decreases when pixels are less.

As per our contrivance, we performed every operation using Python Programming to reduce the coding complexity. The module used to plot the histogram graph is OpenCV. The function used in the aspect of OpenCV is calcHist() [12]. It is generally interpreted as cv2.calcHist(). It is used to calculate the Histogram of the input image, the general syntax of calcHist() is given as

"cv2.calcHist(image, channel, mask, hist_size, ranges)". To get a clear about the usage of this function along with this module we need to be familiarized with the parameters given in the syntax of function.

Image is the location of source image it may be either predefined using cv2.imread('image_name.image_format') function or defined in the syntax itself. It should be always enclosed in square brackets "[]". i.e. [img] where img = cv2.imread('varun.jpg').

Channel – it is also represented in square brackets. It is the index of the channel of the histogram. It differs from the type of image, if it is grayscale then it is [0]. For color image it can surpass [0], [1], [2] which varies as Red, Green and Blue colors.

Mask - if we are supposed to determine the complete histogram of full image then it is replaced as 'None' but if there are restrictions to plot histogram then it has to be replaced as mask where image has to be masked.

hist_size – it is equal to BIN count. As specified before we represent axis as pixels which ranges from 0 to 255 i.e. we require 256 values to show histogram. In some cases, we are directed to plot a histogram for a region between 0 to 32, 33-64, … then we only require 32 values. So we partition the complete histogram to 8 subparts and each value of subpart is same as the sum of all pixel count. Each subpart is called BIN. So for our proposed work it is [256]. It is also represented in square brackets.

Range: It's our specified range where we would like to plot histogram. For our convenience we took our range as [0, 256].

We plotted histogram after filtration and morphological operation to avoid involvement of noise and to get clear interpretation of image. The statement given in the code is "hist = cv2.calcHist([closing], [0], None, [256], [0,256])".Matplotlib.pyplot() is used to plot the histogram to the screen which is given as pyplot.subplot(222), pyplot.plot(hist), pyplot.show(). It works similar to its function in Matlab.

The following pictures shows the clear difference in histogram between the cancerous liver and non–cancerous liver. Fig 9 (a) represents non-cancerous results and Fig 9 (b) represents cancerous results.

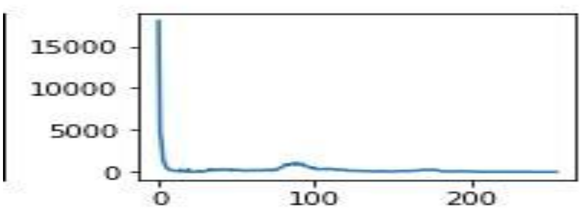

Fig 7 (a): Non-Cancerous Histogram

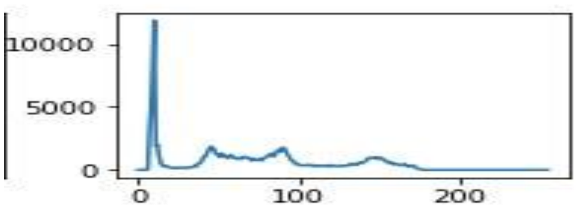

Fig 7 (b): Cancerous

Histogram

F. Frequency Domain of Image: Fourier Transform:

Fourier transform of an image is handled to inspect frequency characteristics of an image, for an image Discrete Fourier transform (DFT) is used to identify frequency characteristics[13]. Fast Fourier Transform (FFT) is used to measure DFT. Frequency is inversely proportional to time period in case of signals, if signal doesn't vary for long time period frequency will be low, if it varies for long duration frequency will be high. So, if we consider an image as a signal it is sampled in both x and y directions and further FFT is applied on both x and y directions [14].

Here, we adopted the module named as numpy and package fft. The complete syntax is given as "np.fft.fft2(source_image)".

Once we end with up results, the frequency obtained will be situated on top left corner to bring it to center we are required to shift that component. It is done using simple function "np.fft.fftshift()". Then we can calculate the magnitude spectrum using "20*np.log(np.abs(fshift))" [15]. The following figures show the variation between cancerous and non-cancerous report.

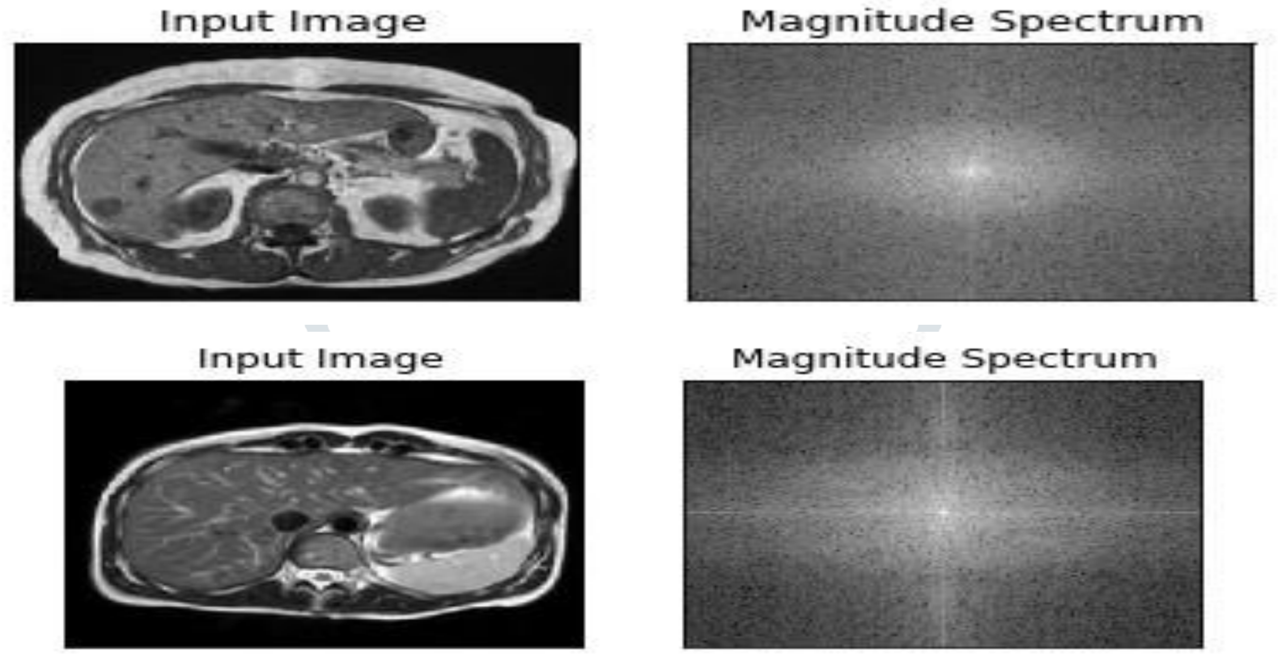

Fig 8 (a): Cancerous cell Fig 8 (b): Non-Cancerous cell

III. CONCLUSIONS AND FUTURE SCOPE:

A miscellaneous operation is done to image for amplification of exact differences between normal cell and cancerous cell. The operation includes filtration, morphological operation, thresholding, histogram, Fourier transformation. Further enhancements have to be done for clear identification of differences. This plots the exact difference between normal cell and cancerous cell.

Hence, the intense investigation in future can lead to automation of diagnostics, reducing cost and accurate results. The graph can be analysed and automated for diagnostics report. Further work can help in determination of stage of cancer by creating a database comparing all the results obtained.

It is estimated that this contrivance can be applied in real world for accurate results and in less duration with less cost.

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