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Abstract: The detection and treatment of lung cancer at an early stage is very much important when it bothers human mortality rate. Techniques such as Positron Emission Tomography (PET) and Computed Tomography (CT) are not capable enough to detect the cancer at an early stage. Symptoms usually show up when the disease is in advanced stage and the survival rate of the patients is 17.8%. This method is about diagnosing the disease at early and crucial stages with intelligent computational techniques with various distortion removals by segmentation techniques and algorithms, which are the root concepts of image processing. The CT images are obtained from Wayne State University, School of Engineering and Medicine. These images are analyzed using MATLAB. Also this method is tested on a public dataset containing 983 lung cancer images and this method is able to achieve 98% of the success rate in tumor detection.

Keywords: Lung Cancer, Watershed Segmentation, Filtering Techniques.

1 INTRODUCTION

Cancer is basically defined as an uncontrolled cell growth/division in the body. It is caused by mutations(changes in the genetic material). The changes in the genetic material can occur due to many reasons, one among them is consuming tobacco products. Cancer or tumor is basically of two types. They are:

1. Benign Tumor: Uncontrolled group or lump of cells enclosed in a connective tissue.

   Treatment for this type of tumor is easier when compared to other type of tumor. These tumors can be removed using surgery or chemotherapy etc., Drugs prescribed by a medical practitioner are consumed regularly, such that patient can feel better.

2. Malignant Tumor: Uncontrolled group or lump of cells not enclosed in a connective tissue. They spread all over the body part/body and is a harmful tumor. Treatment can include Chemotherapy, Exposure of cancer affected area to UV rays etc.. Detection of cancer in early stages is actually an issue now a days. Because symptoms does not show up until unless the disease goes into the advanced stages. But it is always suggested to stay and lead a healthy life in order to prevent cancer. But if cancer is detected in early stages, it can be completely cured. Our proposed method helps in detection of cancer at early stages using image processing techniques.

2 FORMULAS MATLAB COMMANDS

a. Conversion of Input image to Gray scale:

   rgb2gray(x);  % Converts an input image(x) into gray scale format.

b. Removal of noise in the images by using filters:

   medfilt2(g, [m n], 'symmetric');  % Implements/Creates a Median filter with window of size (m X n). This filter is applied on entire input image(g).

c. Application of DCT and IDCT Transform on the images:

   dct2();  % Implements/Performs a Discrete Cosine Transform on the image.

   idct2();  % Implements/Performs an Inverse Discrete Cosine Transform on the image.

The formulas for performing DCT and IDCT operations are as follows:

\[ C(i,k) = \frac{2 \pi \theta}{N} \sum_{n=0}^{N-1} \sum_{m=0}^{N-1} f(m,n) \cos \left( \frac{(2m+1)\pi}{2N} \right) \cos \left( \frac{(2n+1)\pi}{2N} \right) \]

where \( i, k = 0, 1, \ldots, N-1 \), and \( \alpha() \) is defined by:

\[ \alpha(k) = \begin{cases} \frac{1}{\sqrt{2}} & \text{for } k = 0 \\ 1 & \text{for } 1 \leq k \leq N-1 \end{cases} \]

\[ f[m,n] = \frac{2}{N} \sum_{i=0}^{N-1} \sum_{k=0}^{N-1} C(i,k) \alpha(i) \alpha(k) \cos \left( \frac{(2m+1)\pi}{2N} \right) \cos \left( \frac{(2n+1)\pi}{2N} \right) \]

where \( m, n = 0, 1, \ldots, N-1 \).
d. Enhance this obtained image using Bottom Hat Transform filter:

imbothat(bw,se); % Performs Bottom Hat Filter Transform for input image(bw). Where e is the structuring element of the filter. se can be of any shape which can be applied on the image.

e. Applying Watershed Algorithm:

watershed(); % Performs watershed algorithm on the image.

f. Applying Histogram Equalization Algorithm:

histeq();% Performs histogram equalization of an image.

3 PROPOSED METHOD

The step by step procedure of proposed method is as follows:

1. Initially, human lung image is taken and is converted from RGB scale to gray scale for ease of image processing.

2. Apply a median filter on the image to remove noise/distortions in the image.

3. Apply Discrete Cosine Transform (DCT) and Inverse Discrete Cosine Transform(IDCT) transform on the filter output.

4. Design a Bottom hat Filter and apply it to the image, so that any remaining distortions/noise can be removed.

5. Apply watershed algorithm on the image. Watershed output will be an RGB scale image.

6. Convert RGB scale image into gray scale image and perform histogram equalization on the watershed gray scale image.

7. Apply boundary extraction operations on the image. From which, one will clearly spot the cancer affected area in the image.

4 EXPERIMENTAL RESULTS/IMAGES:

![Input Image](image1)

![Boundary extraction of Image](image2)

Fig 1. Cancer Affected Lung Image and its experiment result:

![Input Image](image3)

Detection of cancer is observed in Fig 1 which shows right side of the lung is deeply affected
Fig 2. Normal Lung Image and its experiment result

4. CONCLUSION

The above method is processed in two steps processing of noisy input image using filter and segmentation and Morphological operations on CT image. The cancer affected lungs region can be observed in the final output image to CT input image provided. This method is very much effective in detecting the cancer in the early stages.

5. FUTURE WORK

The proposed method can also be applied to other forms cancer types like breast cancer, skin cancer etc. Also proposed method finds its application in the medical research as well.

REFERENCES

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