SICKLE CELL DETECTION USING MARKER-CONTROLLED WATERSHED SEGMENTATION

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ABSTRACT

Any diseases are caused by infection in the blood. The blood sample consists of different cells like RBCs, WBCs, and Platelets. Detection of these cells will help in diagnosing the diseases. More number of sickle cells in RBC will cause repeated infections, and periodic episodes of pain.This paper helps to detect the sickle cell by using various techniques of image processing.

Keywords: Image processing, Sickle cell, Segmentation, Threshold, Watershed

I. INTRODUCTION

Sickle cell disease is a group of disorders that affects hemoglobin, the molecule in red blood cells that delivers oxygen to cells throughout the body. People with this disorder have atypical hemoglobin molecules called hemoglobin S, which can distort red blood cells into a sickle, or crescent, shape.[1]

Edge detection is an image processing technique for finding the boundaries of objects within images. It works by detecting discontinuities in brightness. Edge detection is used for image segmentation and data extraction in areas such as image processing, computer vision, and machine vision. [2]

A watershed is a basin-like landform defined by highpoints and ridgelines that descend into lower elevations and stream valleys. Different approaches may be employed to use the watershed principle for image segmentation.

- Local minima of the gradient of the image may be chosen as markers, in this case an over-segmentation is produced and a second step involves region merging.

Marker based watershed transformation make use of specific marker positions which have been either explicitly defined by the user or determined automatically with morphological operators or other ways. This paper deals with detection of sickle cell using the marker-controlled watershed technique. A sample image of microscopic blood smear is shown in Fig 1. We have considered the gray level image for the detection of the sickle cell.

II. PREPROCESSING

The proposed image processing system consists of following steps:
  a) Thresholding.
  b) Segmentation.

2.1 Thresholding

The thresholding methods replace each pixel in an image with a black pixel if the image intensity $I_{i,j}$ is less than some fixed constant T (that is, $I_{i,j} < T$), or a white pixel if the image intensity is greater than that constant. In the example image on the right, this results in the dark tree becoming completely black, and the white snow becoming complete white. [3]

2.2 Segmentation

Image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation istypically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics. [4]

III. OBJECTIVE

The objective of this paper is to determine the shape of the sickle cell and the normal blood cell. The proposed work will help to determine the sickle cells in RBCs using image processing techniques.

3.1 Image Acquisition

The image is first acquired of an existing image can be loaded from the memory. We shall consider that the acquired image is in RGB format which is a true colour format for an image. In MATLAB, the captured or imported RGB image is three dimensional and each pixel is represented by an element of a matrix whose size corresponds to the size of the image.

Fig.1

3.2 Preprocessing

Preprocessing images commonly involves removing low-frequency background noise, normalizing the intensity of the individual particles images, removing reflections, and masking portions of images. Image preprocessing is the technique of enhancing data images prior to computational processing.The original image is converted into gray image which helps to acquire the clear image by filtering, segmenting and applying thresholding to the grayscale image.

Fig.2

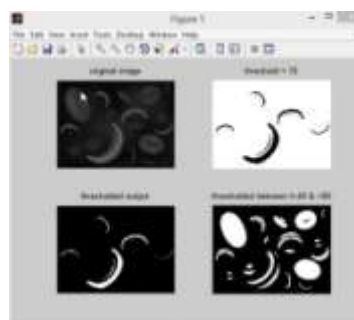### 3.3 Marker-Controlled Watershed Segmentation

The watershed transform finds "catchments basins" and "watershed ridge lines" in an image by treating it as a surface where light pixels are high and dark pixels are low. One of the most important drawbacks associated to the watershed transform is the oversegmentation that commonly results. The usual way of predetermining the number and approximate location of the regions provided by the watersheds technique consists in the modification of the homology of the function to which the algorithm is applied. This modification is carried out via a mathematical morphology operation, geodesic reconstruction, by which the function is modified so that the minima can be imposed by an external function (the marker function). All the catchment;! basins that have not been marked are filled by the morphological reconstruction and so transformed into nonminima plateaus, which will not produce distinct regions when the final watersheds are calculated. Segmentation using the watershed transforms works well if you can identify, or "mark," foreground objects and background locations. Marker-controlled watershed segmentation follows this basic procedure:

a. Compute a segmentation function. This is an image whose dark regions are the objects you are trying to segment.
b. Compute foreground markers. These are connected blobs of pixels with in each of the objects.
c. Compute background markers. These are pixels that are not part of any object.
d. Modify the segmentation function so that it only has minima at the foreground and background marker locations.
e. Compute the watershed transform of the modified segmentation function.

IV.EXPERIMENTAL RESULTS

4.1 Thresholding

We have applied 0.3 as threshold value and threshold output value is set as 'r>70'. Hence we get the following output as,

Fig.3

4.2 Marker-Controlled Watershed Segmentation

Segmentation of image will help to detect the image and edge can be determined by using this segmentation technique. Sickle cell can be detected using this segmentation approach. Hence the output image can be represented as below:
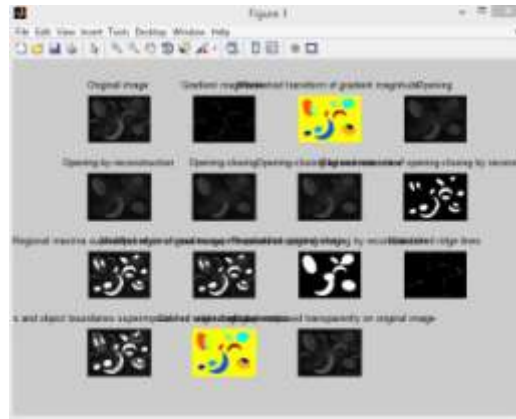

Fig.4

V. CONCLUSION

Segmentation of image will provide proper edges and helps to detect the sickle cell in the RBC sample blood. Hence by detecting the sickle cells, it's possible to diagnose in a better way and helps to determine the diseases.

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