Identifying Deviations in Microscopic Blood Images using Parallel Computing and Divide and Conquer Image Fragmentation

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ABSTRACT

Most of the patient diagnosis revolves around in identifying abnormalities in their respective medical images. These images are of various types, likely Ultrasound, CT scan, MRI and microscopic images like bio-chemical slides, micro-biological slides & pathological slides. Few abnormalities are fractures, bad cells in blood, tumors, fungal identification etc. Finding the abnormal portions in these images needs expertise by the physician; this apt identification promotes and guarantees healthy medication by the physician or surgeon to patient. In medical microscopic images normal portions and abnormal portions are mixed together. None of the abnormal portions are related to abnormal and normal portions of image i.e. deviations are scattered among normal portions of image. These deviations are not present in some portions for specific area in the images. None of these deviations are overlapped nor can be grouped together into a single portion physically in the image. Deviations are isolated along with normal portions of images. Identifying such deviations is vital. In previous methods these deviations are identified used BFS and Shortest Path Algorithm. This paper focuses on identifying deviations using parallel computing applied over fragmented portions of blood images using divide and conquer.

Keywords : BFS, Deviations, Fragmentation, Divide & Conquer, Shortest Path Algorithm, Parallel Computing.

I. INTRODUCTION

Medical Imaging is the technique and process of creating virtual representations of the interior of a body for clinical analysis and medical intervention, as well as visual representation of the function of some organs or tissues. Different types of medical images are Scanned Images and Microscopic Images. Scanned images include MRI scan, CT scan, PET, X-Ray, Ultrasound.

Types of Medical images
Magnetic Resonance Imaging (MRI)

MRI is a medical imaging Technology that uses radio waves and a magnetic field to create detailed images of organs and tissues. MRI is used to evaluate blood vessels, Abnormal tissues, Bones and Joints, Spinal injuries etc.

Computed Tomography (CT)

Computed Tomography (CT), is a medical imaging method that combines multiple X-ray projections taken from different angles to produce a detailed cross-sectional images of areas inside the body. CT images allow doctors to get very precise, 3D views of

certain parts of the body. CT is used to evaluate presence, size, location of tumors, Bone injuries, Organs in chest, abdomen etc.

Positron Emission Tomography (PET)

PET is a nuclear imaging technique that provides physicians with information about how tissues and organs are functioning. PET is used to evaluate Neurological diseases such as Alzheimer's and Multiple Sclerosis, Cancer etc.

Ultrasound

Diagnostic ultrasound, also known as Medical Sonography, uses high frequency sound waves to create images of parts inside the body. It is used to evaluate Pregnancy, Abnormalities of heart and blood vessels etc.

X-Ray

X-rays use ionizing radiation to produce images of a person's internal structure by sending X-ray beams through the body. X-ray images are used to evaluate Broken bones, Cavities, Lungs etc.

Microscopic Images

Microscopic images are used in medical diagnosis [12]. They were made with a very high resolution of 4096 x 2160 pixels (4K), which is four times as many pixels as High-Definition image (1920 x 1080 pixels).

The various types of microscopic images are:
● Biochemical sides
● Pathological slides
● Micro-biological slides

Finding the abnormal portions in these images needs expertise by the physician; This apt identification promotes and ensures healthy medication by the physician to patient.

II. RESEARCH ELABORATIONS

Anaemia

The cellular part of blood molecule contains several different cell types like red blood cells, white blood cells and platelets. Anemia is the most common disorder of the blood. "Anemia", the name is derivative from the ancient Greek word anemia, which means "Lack of Blood". It is possible because of reduction in Red Blood Cells (RBCs) or resulting in lesser than normal quantity of haemoglobin in the blood. However, it can also include decreased oxygen-binding ability of each haemoglobin molecule due to deformity or lack in numerical development. Anemia is actually a sign of a disease process rather than being a disease itself. It can be either classified as acute or chronic. In chronic anemia, symptoms typically begin slowly and progress gradually; whereas in acute anemia, symptoms can be abrupt and more distressing. Among many factors, both nutritional (like vitamins and mineral deficiencies) and non-nutritional (like infection and haemoglobin opathies), that contribute to the onset of anemia; Iron Insufficiency and malaria plays a significant role. For men, anemia is typically defined as hemoglobin level of less than 13.5 g/dl and in women as hemoglobin of less than 12.0 g/dl.

Sickle Cell Anemia

Sickle cell disease is an inherited blood disorder. Red blood cells contain hemoglobin which carries the oxygen in the blood. They are round and flexible which enables them to travel through small blood vessels to deliver oxygen to all parts of the body. These cells normally live about 120 days. Sickle cell disease causes red blood cells to become crescent shaped, which causes them to break apart easily. This ultimately causes anemia because the cells only live 10-20 days.
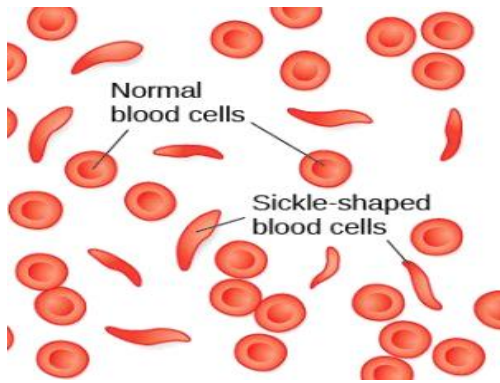
Figure.1. Sickle cells and Normal Blood Cells

Characterization of Sickle-Cell Anemia:

When the abnormal sickle-shaped cells in the blood are identified, a diagnosis is made.

- ✓ Normal Cell: Normally blood cells are round and flexible and flow easily through blood vessels.
- ✓ Sickle Cell: In sickle cell disease, certain red blood cells become crescent-shaped. These abnormal red blood cells, carrying abnormal hemoglobin known as hemoglobin S, are fragile.
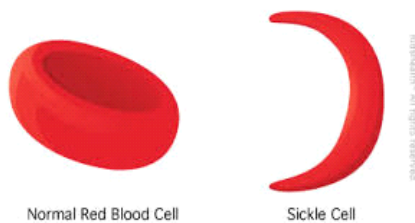

Figure. 2. Normal RBC and Sickle Shaped RBC

In human health, blood health is very important, and the early diagnosis of diseases is necessary to prevent death and the worsening of disease. With the development of information technology, image-processing technology is becoming an essential and effective tool in scientific research. It is especially widely used and effective in the field of biomedical engineering. Finding a faster, more efficient methods to diagnose this kind of disease by using image segmentation so that sickle cells can be detected in blood samples is an essential part of detecting this disease. The goal of this thesis is to demonstrate how image processing technology can be useful in the detection of sickle cell disease.

III. EXISTING SYSTEM

There have been many studies about sickle blood cell detection. One of them is the "Detection of Abnormal Blood Cells Using Image Processing Technique" by Malher Bhatt and Shashi Probha. In this study, the authors try to detect abnormal blood cells based on form factor and using image segmentation. The form factor they used calculates the circularity shape of the cell, and if the cell not circular, it is counted as an abnormal cell.
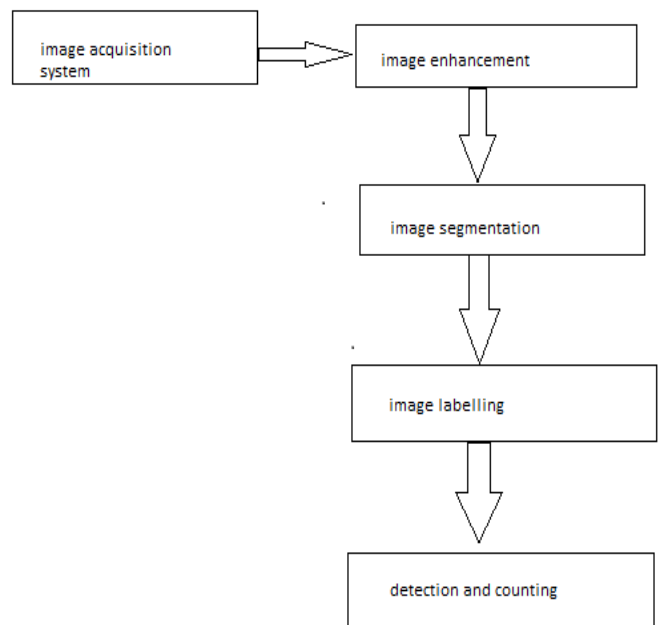

Figure. 3. Block diagram for detecting abnormal cells

A. Image Acquisition
The digital microscope is interfaced to a computer. The microscopic images are obtained as digital images. The resolution of the digital image depends on the type of digital microscope used [7].

B. Image Enhancement
For better segmentation of the blood cells, the imported image has to be enhanced. This improves the quality of the image by enhancing the details [7].

C. Image 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 is typically 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. [9].

D. Abnormal Blood Cell Detection

Form factor threshold is fixed for different abnormal cells. Based on the form factor, the abnormal cells are detected. Malher and Probha started with reading the image and then converted it to a grayscale image. They then used edge detection to detect the abnormal cells. Edge detection is an image segmentation technique that determines the presence of an edge or line in an image and outlines the edge in an appropriate way. The main purpose of edge detection is to simplify the image data in order to minimize the amount of data to be processed. Edge detection is followed by a labeling stage and then form factor calculation [7]. Form Factor=4*Pi*area/(perimeter*perimeter).Here form factor is calculated and it is used to determine whether the cell is normal or sickle cell. In this the sickle cells can only be counted but cannot be connected.

IV. PROPOSED ANALYSIS

A. Flow of Proposed Solution

The blood cell image (microscopic) is given as input and later the blood cell image is enhanced to get in the desired format. After being enhanced, these can be divided into segments based on colour space. After that we can perform classification techniques to detect normal and abnormal cells. After that noise, small objects are removed. These will done by detecting the objects with area that are less than a specific value.

And this can be done using the function Bwareaopen( ). Next we can count the number of sickle cells and red blood cells and their percentages.
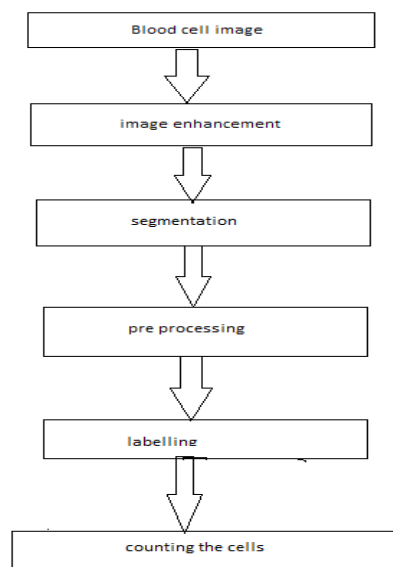
V. IMPLEMENTATION

MATLAB environment to implement the new algorithm, the "MATLAB" tool is used. MATLAB has an image processing toolbox, which contains all functions that are used to analyze the image such as reading, enhancement, converting from one image type to segmentation, labeling and more. The functions that used to run the new algorithm are described below [7].

A. Reading Image (Imread)

MATLAB deals with the image as a two dimensional matrix. Imread reads the image into MATLAB's environment as a matrix [7].
Basic Syntax

Image=imread ('file-name');

MATLAB reads the image file "file-name" into an array image. Imread can read many different formats such as JPG, PNG, GIF and TIF [7].

B. Showing Image (Imshow)

Imshow displays images on the MATLAB desktop.

Basic Syntax

Imshow (I)

MATLAB displays the image I in a graphics figure, where I is a grayscale, RGB (truecolor), or binary image. For binary images, imshow displays pixels with the value 0(zero) as black and 1 as white [6].

C. Segmentation(cellSegmentation)

In this it segments into different parts by using this function.

Basic Syntax

cellSegmentation(Inputimage,colourspace)

In this the colourspace must be RGB, CMYK, YCbCr.

D.Preprocessing(bwareaopen)

bwareaopen can be used to remove noise and small objects.

Basic Syntax

bwareaopen(BW, 100)

bwareaopen is a filter can be used to remove noise and performs classification to extract sickle cells [8][9].

E.Labelling(regionprops)

regionprops can be used to adding the bounding boxes to cells.

Basic Syntax

regionprops(BW2, 'all')

These bounding boxes can be used for counting the number of sickle and RBC.

F.Counting

In this we can count the number of sickle cells and red blood cells and their percentages [10].

Sickle cell percentage:

wbcPercent = (whitecount ./ totalCells).* 100;

RBC percentage:

rbcPercent = (redcount ./ totalCells).* 100;
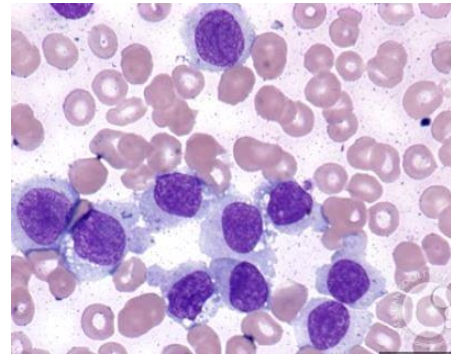
VI. ANALYSIS AND RESULTS

Sample

Input Image

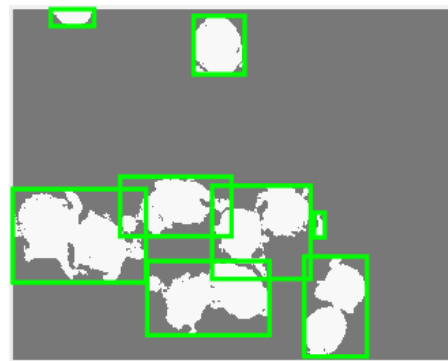
Figure.4. Results after reading input sample1.jpg file

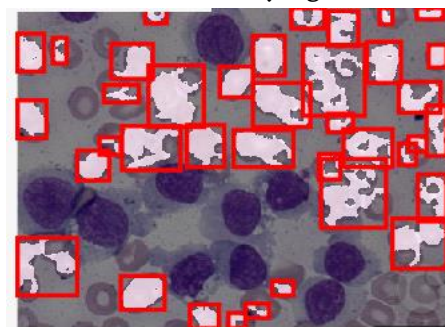**Figure.5.** Results after identifying sickle cells in RGB

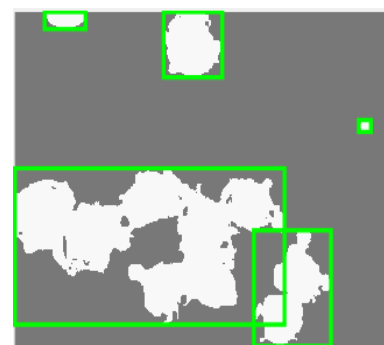**Figure.6.** Results after identifying RBC in RGB

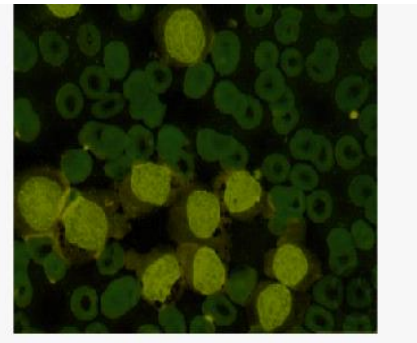**Figure.7.** Results after identifying sickle cells in CMYK

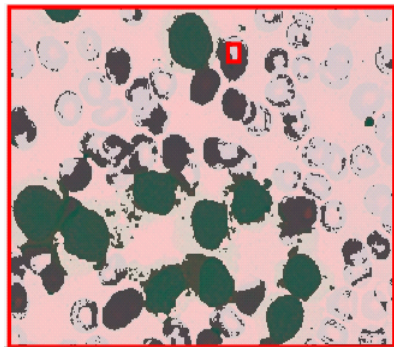**Figure.8.** Results after identifying RBC in CMYK

Figure.9. Results after identifying RBC in YcbCr.

VII.   CONCLUSION

The proposed algorithm counts the cells by Identifying Deviations in Microscopic Blood Images using Parallel Computing and Divide & Conquer Image Fragmentation. Analysing to the prior proposed solutions, this solution counts all possible units without ignoring any unit.

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