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Department of Electronics & Communication Engineering

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Annexure I

1. Project Title: Identification of Sickle Cells using Digital Image Processing

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1. ABSTRACT & OBJECTIVE

1.1 ABSTRACT

Sickle Cell Anemia is a blood disorder which results from the abnormalities of red blood cells and shortens the life expectancy to 42 and 48 years for males and females respectively. It also causes pain, jaundice, shortness of breath, etc. Sickle Cell Anemia is characterized by the presence of abnormal cells like sickle cell, ovalocyte, anisopoikilocyte. Sickle cell disease usually presenting in childhood, occurs more commonly in people from parts of tropical and subtropical regions where malaria is or was very common. A healthy RBC is usually round in shape. But sometimes it changes its shape to form a sickle cell structure; this is called as sickling of RBC. Majority of the sickle cells (whose shape is like crescent moon) found are due to low hemoglobin content.

A digital image processing algorithm to identify of sickle-cells present in thin blood smears is developed. Images are acquired using a charge-coupled device camera connected to a light microscope. Proposed system techniques are used to identify erythrocytes (red blood cells) and Sickle-cells present on microscopic slides.

The goal of this thesis is to identify only the sickle cells in the input blood sample image which is useful for pathologist to identify sickle cell anemia easily.

The red blood cell smears were obtained from Vijaya Hospital, Visakhapatnam. The proposed system identifies the sickle-cells in patient and these results will be very helpful for effective diagnosis of the disease.

1.2 Motivation

- Most of the tribal people are dying with this anemia
- The pathologists will take 2 to 3 days for detection of sickle cells in the patient’s blood sample
- PM Modi seeks help from Japan to eradicate this disease
- So we tookup this project by the motivation of Modi sir to decrease the time of identification

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SUNIL CHACKO

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Modi realises India's sickle cell problem

During his recent trip to Japan, Prime Minister Narendra Modi met with Nobel Prize winning stem-cell researcher Prof Shinya Yamanaka and the two countries decided to work together on sickle cell anaemia. Although Indian medical colleges usually describe sickle cell anaemia as an African disease, it affects some of the poorest, most disadvantaged Indians — for example, tribals living in or near forests teeming with mosquitoes.

This seems an appropriate theme for future partnership ventures as India and Japan have joint interests to collaborate on business and social projects in Africa.

Prof Shinya Yamanaka

1.3 Objectives

The main objectives of this work can be summarized as follow:

1. Identify Best algorithms suited for medical image in order to identify sickle cell anemia
2. Identifying only sickle cells in the input image
3. Counting numbers of sickle cells

2.1 Block Diagram:

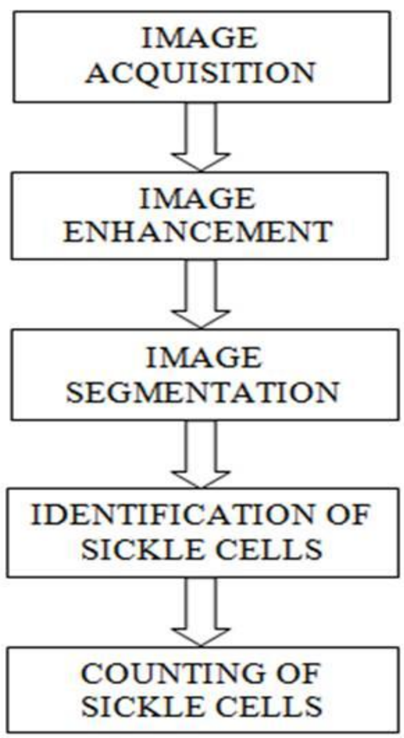

Figure: Block Diagram for Identification of Sickle Cells

2.2 OPERATIONS PERFORMED

2.2.1 IMAGE ACQUISITION

A blood film is produced by pricking pulp of any finger by surgical needle in aseptic condition. Drop of blood not larger than pin head taken on a grease-free glass slide at half inch from the right side. Another glass slide end held at 45° touching the blood drop is lowered to 35° then pushed gently to the left till blood is exhausted giving a tailing effect. Then the slide is air dried and labelled. The film is stained either by Leishman’s stain or Giemsa stain. The stained film is examined under charge coupled photo microscope. This photograph is fed to computer and is ready to be used as the input to the program and there are some limitations while examining under CCD microscope for sickle cell identification i.e

2.2.2 HANDLING IMAGE MAGNIFICATION

The image taken after enlargement using charge coupled photomicroscope, so the amount of magnification should be inserted into the system and then the method will compute the real area of objects upon the amount of magnification. There are many magnification equations such as:

- Magnification value * 0.45

This equation assimilates minimum area of RBCs after magnification, the equation used as a variable to be dynamic with magnification, result of this equation has been used as compare factor for area, in this application it will be used in one of the steps for recognizing small cells.

Example: Magnification = 2000s

Minimum area of RBCs after magnification = 900 pixels

- Magnification value/400

This equation assimilate the radius of normal cells, value used as a dynamic with Magnification, it has been used to recognize if this cell is regular or not, in this application it will be used in one of the steps for recognizing sickle cells.

2.2.3 IMAGE ENHANCEMENT

The aim of image enhancement is to improve the interpretability or perception of information in images for human viewers, or to provide `better' input for other automated image processing techniques. Image enhancement techniques can be divided into two broad categories spatial domain and frequency domain among those we have an efficient initial outputs from spatial domain method.

2.2.3.1 Spatial domain methods, which operate directly on pixels

- Grey Scale Manipulation.
- Histogram Equalization.
- Image Smoothing.
- Image Sharpening.
- Filtering.
- High Boost Filtering.

2.2.4 Grey scale manipulation:

The simplest manipulation that makes multi gray level image (RGB) to single gray level for making further manipulation easier in which it contains 2 techniques

1. Gray Scale Extraction
2. Green Plane Extraction

The gray scale extraction from input RGB image represents the 30% of red, 60% of green and 10% blue of the input color image. The green plane is extracted from the imported blood cell image. The other planes such as red and blue are not considered because they contain less information.

2.2.5. 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.

2.2.6. Thresholding

Thresholding is the simplest method of image segmentation. From a grayscale image, thresholding can be used to create binary images and there are so many thresholding techniques among those we approached pixel value based thresholding.

2.2.7. IMAGE MORPHOLOGY

Morphology is a broad set of image processing operations that process images based on shapes. Morphological operations apply a structuring element to an input image, creating an output image of the same size. In a morphological operation, the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbors. By choosing the size and shape of the neighborhood, you can construct a morphological operation that is sensitive to specific shapes in the input image.

The most basic morphological operations are dilation and erosion. Dilation adds pixels to the boundaries of objects in an image, while erosion removes pixels on object boundaries. The number of pixels added or removed from the objects in an image depends on the size and shape of the *structuring element* used to process the image. In the morphological dilation and erosion operations, the state of any given pixel in the output image is determined by applying a rule to the corresponding pixel and its neighbors in the input image. The rule used to process the pixels defines the operation as a dilation or an erosion. This table lists the rules for both dilation and erosion

Operation	Rules
Dilation	Pixels beyond the image border are assigned the minimum value afforded by the data type.For binary images, these pixels are assumed to be set to 0. For grayscale images, the minimum value for uint8 images is 0.
Erosion	Pixels beyond the image border are assigned the *maximum* value afforded by the data type.For binary images, these pixels are assumed to be set to 1. For grayscale images, the maximum value for uint8 images is 255.

Table 1: Rules For Dilation and Erosion

2.2.8. IMAGE SUBTRACTION

Image subtraction or pixel subtraction is a process where by the digital numeric value of one pixel or whole image is subtracted from another image. This is primarily done for one of two reasons – leveling uneven sections of an image such as half an image having a shadow on it, or detecting changes between two images. Here we subtracted the eroded image from the binary image to get the difference in the from two images.

2.2.9. IMAGE COMPLEMENT

In the complement of a binary image, zeros become ones and ones become zeros; black and white are reversed. In the output image, dark areas become lighter and light areas become darker this is one of operation that we are using in our approach to outcome .

2.2.10. COUNTING

Counting is based on the output binary image by verifying the connected black components.

2.3.RESULTS

Step-1: Image acquisition

A blood film is produced by pricking pulp of any figure by surgical needle in aseptic condition. Drop of blood not larger than pinhead taken on a grease free glass slide at half inch from right side.

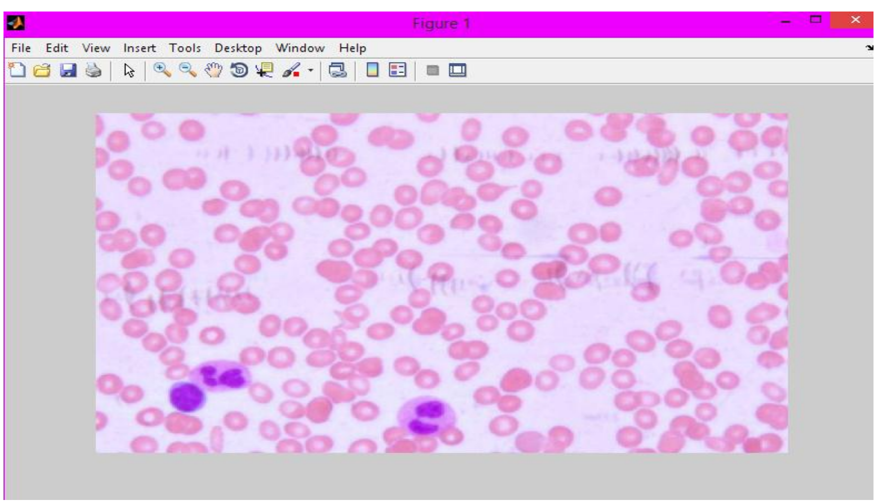

Figure: Input Blood Sample

Step-2: Green plain extraction

Extracting the green plain from the image. Because green plain contains most of the data.

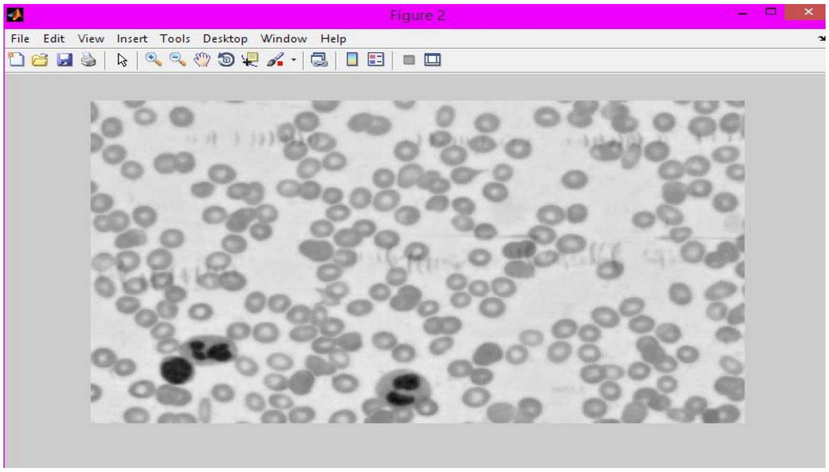

Figure: Enhanced Image

Step-3: **Thresholding**

We separated the image in to two sets of pixel values (binarization) and we also filtered the unwanted data

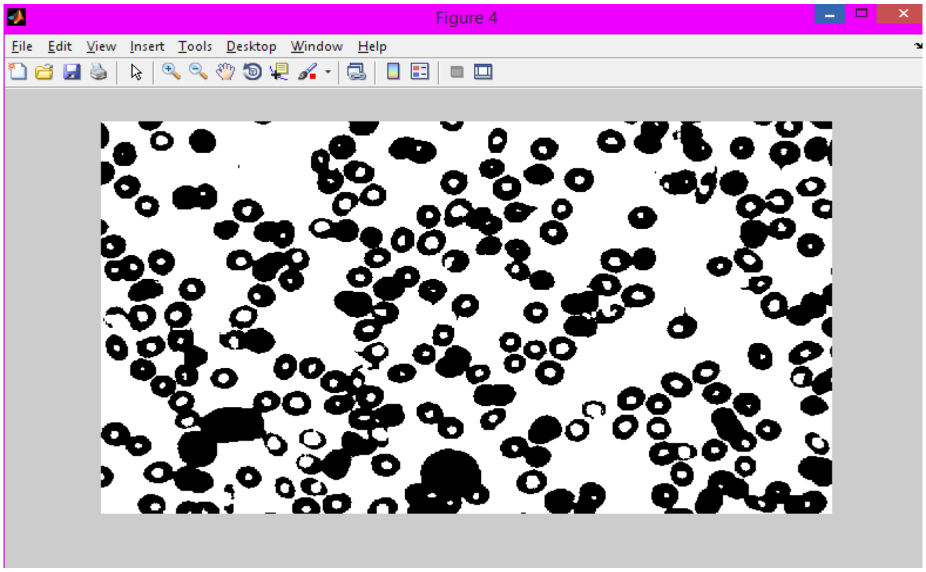

Figure: Segmented output Image Reference 1

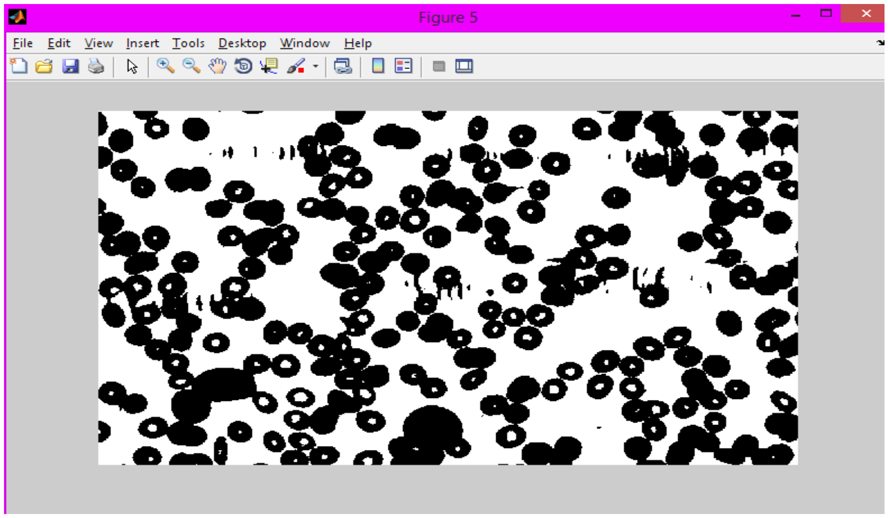

Figure: Segmented output Image Reference 2

Step-4: Image Subtraction

In this stage the difference between two images are obtained.

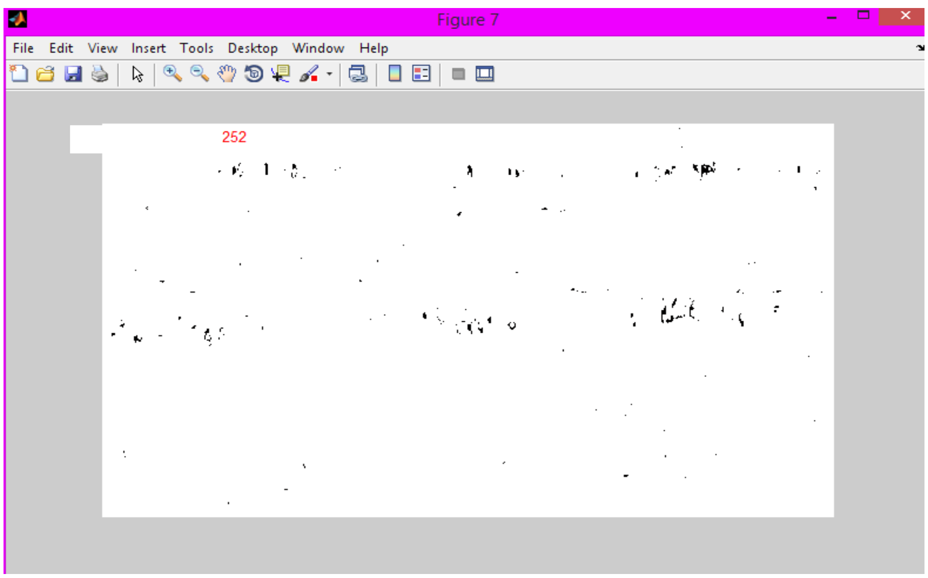

Figure: Sickle Cell Detected Output

Step-7: Counting

Counting the number of cells gives the total number of sickle cells in the image.

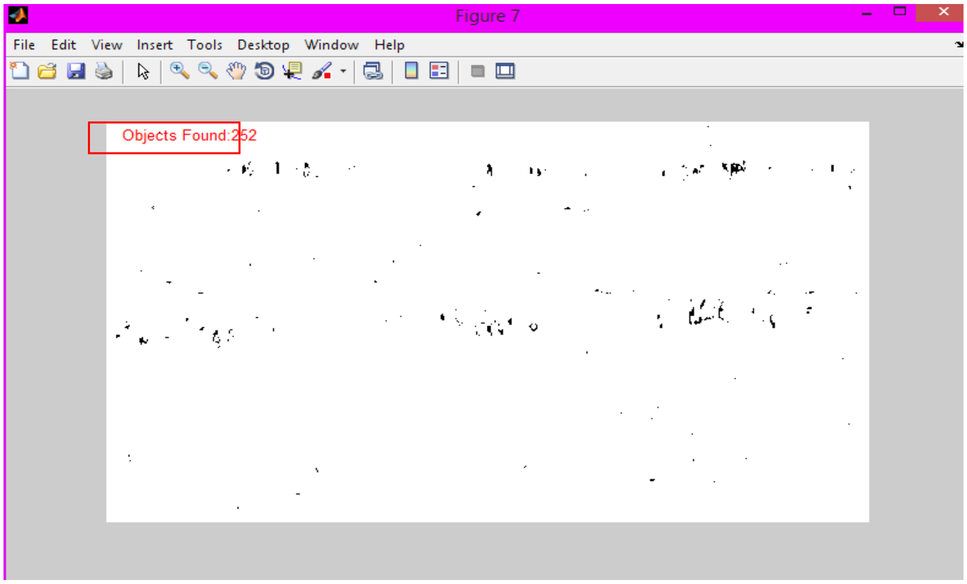

Figure: Displayed the Count of Sickle Cells

3. CONCLUSION

The image processing techniques used in this project, which includes green plane extraction, Thresholding and morphology based image segmentation has helped us to better understand the sickle-cells present in Red Blood Cells (RBCs) in case of sickle-cell patient, and separate the sickle cells from the whole input image and also counted the number of sickle cells present in the output image for percentage of sickles cells in the sample image. Using the image segmentation technique and the following sub-imaging technique, I can obtain the images of particular affected RBCs, i.e. green plane extraction, Thresholding, morphology, sickle cells and finally counting process to determine the characteristics of affected RBCs and thus make an artificial neural network to automatically diagnose sickle-cells disease affected person.