Image Processing Approach for Malarial Parasite Identification

K. M. Khatri[a], V. R. Ratnaparkhe[b], Ph.D, S. S. Agrawal[b], A. S. Bhalchandra[c], Ph.D
a PG Student, b Assistant Professor, c Professor
Dept. of Electronics & Tele-Communication Engineering, Government Engineering College
Aurangabad (M.S.) India

ABSTRACT
Malaria is one of the serious infectious disease which is because of mosquito bites. Diagnosis of malaria is done by microscopic examination of blood. But this diagnosis method is time consuming and requires pathologists. This paper aims to introducing fast and accurate method based on image processing for malaria parasite identification. The database was generated by taking the microscopic images of blood of 30 malarial patients. Based on morphological operations total number of cells are counted. Infected cells are analyzed based on intensity profiles within the cells. The result is validated by comparing with manual analysis. This approach can be used in rural areas where less experts are available and the delayed diagnosis may lead to complications in patients health.

General Terms
Image processing

Keywords
Malaria parasite, image, diagnosis

1. INTRODUCTION
Malaria is a mosquito borne disease caused by the parasites of genus plasmodium. The person gets affected by malaria when malaria parasites are introduced into the circulatory system by infected female anopheles mosquito bites. According to World Health Organisation (WHO) it causes one million deaths per year and nearly 250 million people are affected by malaria [1]. Hence for the prevention and control of vector borne diseases i.e. Malaria, Dengue, Kala-azar, Japanese Encephalitis and Chikungunya Government of India has started National Vector Borne Disease Control Programme (NVBDCP) under Directorate General of Health Services.
The infections of malaria are diagnosed manually. The strained blood files on glass slides are observed under microscope to count the infected blood cells. If sample size of patient is large, there is always a chance to detect inaccurately. Pathologists are required for observing the microscopic images. The special training is to be given to pathologist as less experts are available. There is human error possibility, hence machine based identification is better [2].

2. IMAGE DATABASE CREATION
The database is created by capturing the microscopic images of blood films. As all the cells in blood are very transparent it is stained by using Giemsa stain. This enables to recognize and observe all types of cells. The Assembly of camera and microscope was used to create database. The microscope connected to the personal computer was used to view the blood films and the digital images were captured. Totally 30 images are taken from different blood samples. These images are used as raw data for malarial parasite count.

3. METHODOLOGY
The image processing based approach is developed on MATLAB version 7.12. The steps included are 1) pre-processing, 2) morphological operations, 3) RBC count, 4) contour formation, 5) parasite counting.

3.1 Pre-processing
The segment of input image of (250 × 250) pixels is selected for further processing. The input image may have low brightness and contrast. Pre-processing methods uses small neighborhood of pixel in input image to get the new value of brightness in output image. The different pre-processing methods like normalization, filtering, image plane separation etc. are used [3]. Here normalization of input image is done as pre-processing method. It is the process that changes the range of pixel intensity. It expands the dynamic range of pixel values in an image into the range in which the image appears more normal [4].

3.2 Morphological operations
Morphological operations are image processing operations which processes images based on shapes. It applies a structuring element of specific shape and size on input image. The output image is created by comparing the value of each pixel with its neighbours. These operations are sensitive to the shape of the structuring element [6] [7]. Disk type element having radius 2 is used as structuring element [8]. Morphological closing is used to remove the noise and to separate the Flowchart and result images describing the steps of the proposed algorithm connected blood cells. The closing performs dilation operation followed by erosion operation using predefined structuring element. The closing of image A by structuring element B, denoted by A • B is defined as

$$A \bullet B = (A \ominus B) \ominus B$$

Thus the closing of A by B is dilation of A by B followed by the erosion of the result by B [5].

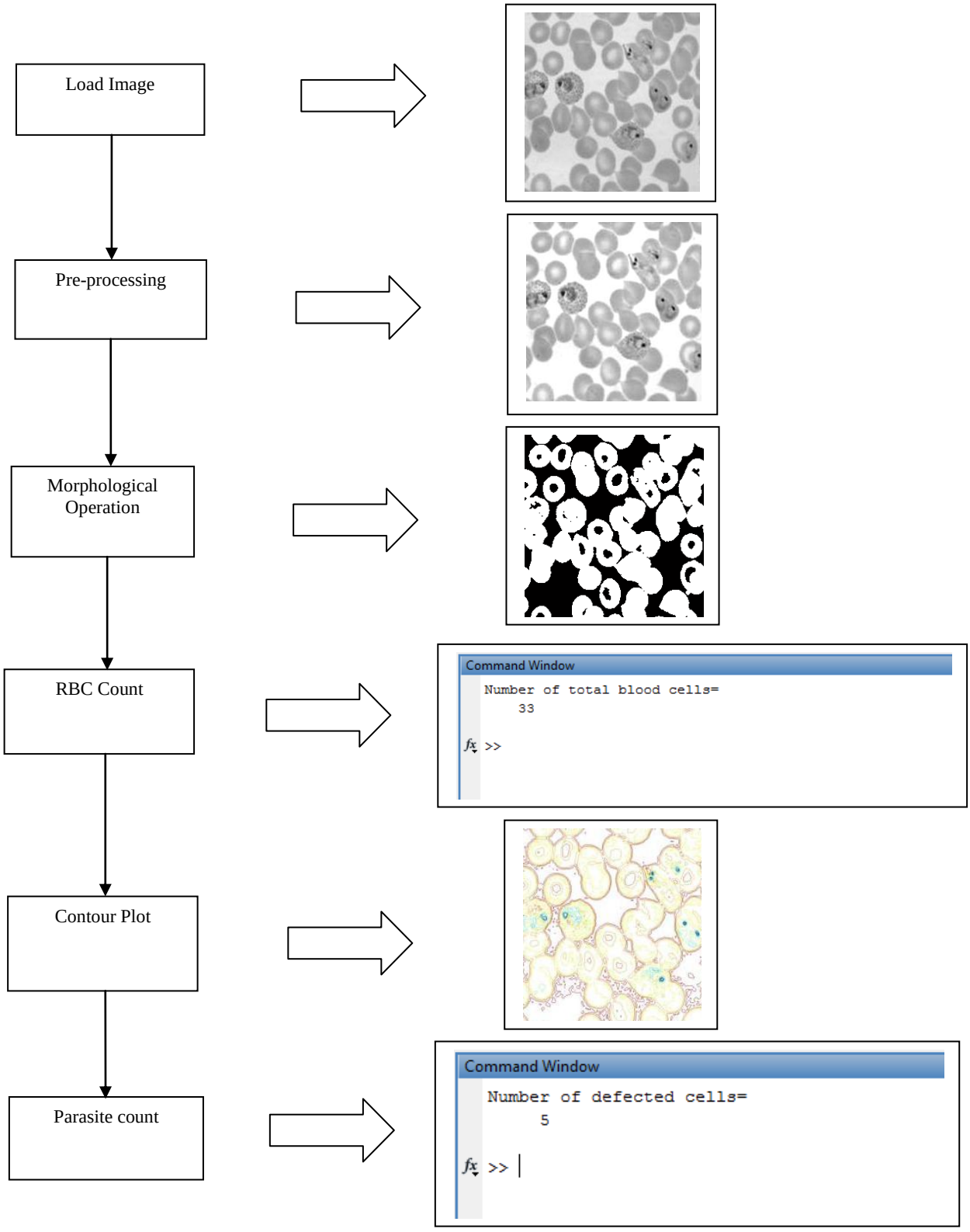

Fig 1: Flowchart and result images describing the steps of the proposed algorithm

3.3 RBC Count

The area of one blood cell is calculated in terms of pixels. By calculating the area of all the cells in image and dividing it by area of one cell we get the total number of blood cells. The approximated integer of the result gives total number cells.

3.4 Contour formation

If the blood cell is infected, specific intensity changes for corresponding red, green and blue planes is observed. Hence by locating the intensity changes in a cell dimension, infected cells can be found out. Contour plot joins the pixels having same intensity [9] [10]. The contour plots of images are formed from

the selected color segment (250 × 250 pixels) of original microscopic image.

3.5 Parasite counting

The image after morphological operation and corresponding contour plot are used for detecting parasites from image. The dimension of each cell is obtained from RBC counting step. The intensity change in cell dimensions of all the cells is located by scanning its contour plot. Thus we get the total number of infected blood cells in an image. As we have the total RBC count and malarial parasite count, percentage of malaria can be determined.

4. RESULT

The results of some of the sample images are reported in Table.1.

Table 1.

Image No	RBC count	IP approach count of malaria parasites	Manual count of malaria parasites	Difference in algorithmic count and manual count expressed in %
Image 1	33	5	6	2.86
Image 2	35	2	3	2.85
Image 3	40	8	5	7.5
Image 4	38	6	4	5.2
Image 5	48	3	3	0
Image 6	35	12	15	8.5
Image 7	30	7	6	3.33
Image 8	20	4	4	0
Image 9	39	4	3	2.56
Image 10	38	9	8	2.63

5. CONCLUSION

This paper work proposes fast and accurate method for malaria parasites count. Results are validated against manual observations and error reported is very less. This approach can be used to train the laboratory fellows. This paper work may assist pathologists to set the diagnosis fast. This work can be extended by increasing database by collecting images from various sources so as to make algorithm robust. A portable stand alone system can be developed by using this algorithm as a software base.

6. ACKNOWLEDGMENTS

We thank the Principle Government Engineering College Aurangabad for providing the setup required for experiment.

7. REFERENCES

[1] WHO: World Malaria Report 2012 World Health Organization.

[2] Selena W.S. Sio, Weiling Sun, Saravana Kumar, Wong Zeng Bin, Soon Shan Tan, Sim Heng Ong, Haruhisa Kikuchi, Yoshiteru Oshima, Kevin S.W. Tan, 2006. ”MalariaCount: An image analysis-based program for the accurate determination of parasitemia”, Science Direct.

[3] Xianfeng Yang, Ping Xue, Qi Tian , “Invariant Salient Region Selection and Scale Normalization of Image” 'School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore Tavel, P. 2007 Modeling and Simulation Design. AK Peters Ltd.

[4] Siwei Lyu Eero P. Simoncelli, “Nonlinear Image Representation Using Divisive Normalization”, Howard Hughes Medical Institute, and Center for Neuroscience New York University.

[5] Rafael C. Gonzalez, Richard E. Woods,”Digital Image Processing” Third Edition (2009).

[6] Young-Won Song and Satish S. Udpa, “A New Morphological Approach For Reducing Speckle Noise In Ultrasonic Images”, Iowa State University Materials Characterization Research Group, Department of Electrical and Computer Engineering, Ames, IA 5001 1

[7] Sumi Yoshino ’, Toshiyuki Tanaka I, Masaru Tanaka ’, Hiroshi Oka2 “Application of Morphology for Detection of Dots in Tumor”, Department of Applied Physics and Physico-Informatics, Keio University, 3-14-1 Hiyoshi Kohoku-ku, Yokohama-shi, 223-8522, Japan

[8] Renata Kalicka, Anna Pietrenko-Dąbrowska, Seweryn Lipiński, “Efficiency of New Method of Removing The Noisy Background From The Sequence of MRI Scans Depending On Structuring Elements Used To Morphological Processing”, Gdańsk University of Technology, Faculty of Electronics, Telecommunications and Informatics

[9] Marek Piotrowski, Piotr S. Szczepaniak, “Active Contour Based Segmentation Of Low-Contrast Medical Images”, Institute of Computer Science, Technical University of tbdi, Lodz, Poland Systems Research Institute, Polish Academy of Sciences, Warsaw, Poland.

[10] A. Nabout, HA. Now Eldin, “The topological contour closure requirement for object extraction from 2D-digital images.”, Group of Automatic Control and Technical Cybernetics University of Wuppertal, 42097 Wuppertal, Germany.