ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijircce.com

Vol. 7, Issue 3, March 2019

Malaria Parasites, Anemia and Leukemia Detection in Blood Using Image Processing

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ABSTRACT: Malaria, Anemia and Leukemia are a serious infectious disease. According to the World Health Organization, it is responsible for nearly one million deaths each year. There are various techniques to diagnose Malaria, Anemia and Leukemia of which manual microscopy is considered to be the gold standard. However due to the number of steps required in manual assessment, this diagnostic method is time consuming (leading to late diagnosis) and level to human error, even in experienced hands. The focus of this study is to develop a robust, unsupervised and sensitive Malaria, Anemia and Leukemia screening technique with low material cost and one that has an advantage over other techniques in that it minimizes human reliance and is, therefore, more consistent in applying diagnostic criteria of Anemia symptoms and signs. Anemia is a condition in which a person has a lower than the normal number of red blood cells or hemoglobin in their blood. Also in our proposed work, Leukemia can be detected on the basis of white blood cell count.

KEYWORDS: Malaria, Anemia, RBC, Parasite, Microscopic Images, Feature Extraction, Threshold and Edge Detection.

I. INTRODUCTION

Malaria Anemia and Leukemia is a life-threatening parasitic disease, caused by the protozoan parasites of the genus Plasmodium and is transmitted through the bite of a female Anopheles mosquito. Inside the human body, the parasite undergoes a complex life cycle in which it grows and reproduces. During this process, the red blood cells (RBCs) are used as hosts and are destroyed afterwards. Hence, the ratio of parasite-infected cells to the total number of red blood cells – called important determinant in selecting the appropriate treatment and drug dose. Approximately, 40% of the world's population, mostly those people living in the world's poorest countries, there is risk of Malaria and Anemia. A child dies of Malaria and Anemia every 30 seconds in the world. Every year, more than 500 million people become severely ill with Malaria and Anemia. Between 300 million and 500 million people in Africa, India, Southeast Asia, the Middle East, the South Pacific, and Central and South America have the disease of Malaria, Anemia and Leukemia. The worldwide annual economic burden of Malaria, Anemia and Leukemia, calculated to include spending on prevention and treatment as well as loss of productivity due to illness, was estimated at US$ 500 million in 2005.The biggest detraction of microscopy, namely its dependence on the skill, experience and motivation of a human technician, is to be removed. Used with an automated digital microscope, which would allow entire slides to be examined, it would allow the system to make diagnoses with a high degree of certainty. It would also constitute a diagnostic aid for the increasing number of cases of imported Malaria and Anemia in traditionally Malaria and Anemia -free areas, where practitioners lack experience of the disease.

Anemia, also spelled anemia, is usually defined as a decrease in the total amount of red blood cells (RBCs) or hemoglobin in the blood. It can also be defined as a lowered ability of the blood to carry oxygen. When anemia comes on slowly, the symptoms are often vague and may include feeling tired, weakness, shortness of breath or a poor ability to exercise. Anemia that comes on quickly often has greater symptoms, which may include confusion, feeling

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like one is going to pass out, loss of consciousness, or increased thirst. Anemia must be significant before a person becomes noticeably pale.

II. LITERATURE SURVEY

Proposed work implement a new approach to low-level image processing -SUSAN (Smallest Unvalued segment assimilating nucleus) Principle, which performs Edge and Corner detection. Images are acquired using a charge-coupled device camera connected to a light microscope. Morphological and novel threshold selection techniques are used to identify erythrocytes (red blood cells) and possible parasites present on microscopic slides. Image features based on color, texture and the geometry of the cells and parasites are generated, as well as features that make use of a priori knowledge of the classification problem and mimic features used by human technicians [1].

This work investigates the possibility of computerized diagnosis of Malaria and Anemia and describes a method to detect Malaria and Anemia parasites (Plasmodium spp) in images acquired from Giemsa-stained peripheral blood samples using conventional light microscopes. Prior to processing, the images are transformed to match a reference image color characteristics. The parasite detector utilizes a Bayesian pixel classifier to mark stained pixels. The class conditional probability density functions of the stained and the non-stained classes are estimated using the non-parametric histogram method [2].

This work describes a fast and reliable mobile phone Android application platform for blood image analysis and Malaria and Anemia diagnosis from Giemsa stained thin blood film images. The application is based on novel Annular Ring Ratio Method which is already implemented, tested and validated in MATLAB. The method detects the blood components such as the Red Blood Cells (RBCs), White Blood Cells (WBCs), and identifies the parasites in the infected RBCs. The application also recognizes the different life stages of the parasites and calculates the parasitemia which is a measure of the extent of infection [3].

Author presents an efficient run-based two-scan algorithm for labeling connected components in a binary image. Unlike conventional label-equivalence-based algorithms, which resolve label equivalences between provisional labels, proposed algorithm resolves label equivalences between provisional label sets. At any time, all provisional labels that are assigned to a connected component are combined in a set, and the smallest label is used as the representative label [4].

CANNY arithmetic operator has been proved to have good detective effect in the common usage of edge detection. However, CANNY operator also has certain deficiencies. Based on the analysis of the traditional CANNY algorithm, an improved canny algorithm is proposed in this work. In the algorithm, self-adaptive filter is used to replace the Gaussian filter, morphological thinning is adopted to thin the edge and morphological operator is used to achieve the refining treatment of edge point’s detection and the single pixel level edge [5].

In this work an automatic technique is proposed for Malaria and Anemia parasites detection from blood images by extracting red blood cells (RBCs) from blood Image and classifying as normal or parasite infected. Manual counting of parasitemia is tedious and time consuming and need experts. Proposed automatic approach is used Otsu thresholding on gray image and green channel of the blood image for cell segmentation, watershed transform is used for separation of touching cells, color and statistical features are extracted from segmented cells and SVM binary classifier is used for classification of normal and parasite infected cells [6].

This work reviews computer vision and image analysis studies aiming at automated diagnosis or screening of Malaria and Anemia infection in microscope images of thin blood film smears. Existing works interpret the diagnosis problem differently or propose partial solutions to the problem. A critique of these works is furnished. In addition, a general pattern recognition framework to perform diagnosis, which includes image acquisition, pre-processing, segmentation, and pattern classification components, is described [7].

This work describes a novel idea to identify the total number of red blood cells (RBCs) as well as their location in a Giemsa stained thin blood film image. This work is being undertaken as a part of developing an automated Malaria and Anemia parasite detection system by scanning a photograph of thin blood film in order to evaluate the parasitemia of the blood. Not only this method eliminate the segmentation procedures that are normally used to segment the cells in the microscopic image, but also avoid any image pre-processing to deal with non uniform illumination prior to cell

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detection. The method Utilizes basic knowledge on cell structure and brightness of the components due to Giemsa staining of the sample and detects and locates the RBCs in the image [8].

This work presents a study of three important issues of the color pixel classification approach to skin segmentation: color representation, color quantization, and classification algorithm. Proposed analysis of several representative color spaces using the Bayesian classifier with the histogram technique shows that skin segmentation based on color pixel classification is largely unaffected by the choice of the color space. However, segmentation performance degrades when only chrominance channels are used in classification. Furthermore, they find that color quantization can be as low as 64 bins per channel, although higher histogram sizes give better segmentation performance [9].

This work removes the human error while detecting the presence of Malaria and Anemia parasites in the blood sample by using image processing and automation. This is achieved by using Image Segmentation techniques to detect Malaria and Anemia parasites in images acquired from Giemsa stained peripheral blood samples. This is comparative study of two methods for detecting Malaria and Anemia parasites; first method is based on segmentation and second uses feature extraction using minimum distance classifiers. Author built the Malaria and Anemia detection system in a robust manner so that it is unaffected by the exceptional conditions and achieved high percentages of sensitivity, specificity, positive prediction and negative prediction values [10].

Advanced image processing algorithm and data mining approach have been used to analysis patient medical information. The pathological data analysis module can process the blood test result to detect anemia type in blood. The image analysis module can identify the abnormal erythrocytes in the smear images using shape based classification. A total number of 38 shape features are extracted from each erythrocyte. Moreover, the supervised decision tree classifier C4.5 is used to classify image samples with sensitivity of 98.1% and specificity of 99.6% [11].

The proposed method can successfully separate the agglomerates of RBCs in spite of grouping of non uniform RBC shapes. Two geometric features are used to distinguish between normal and anemic RBCs: Aspect Ratio and Fourier Descriptors. The Euclidean distance measure is used as a criterion to determine the similarity degree between the templates and testing samples. Also the presence of high number of nucleated RBCs (NRBCs) in severe anemic patients gives erroneous WBC count in automated cell-analyzers and requires correction which is carried out manually [12].

III. PROPOSED SYSTEM

In this work, develop a fully automated image classification system to positively identify Malaria, Anemia and Leukemia parasites present in thin blood smears, and differentiate the species. The method generated will be helpful in the area where the expert in microscopic analysis may not be available. The effort of the method is to detect presence of parasite at any stage. One of the parasites grows in body for 7 to 8 days without any Symptoms. So if this method is incorporated in routine tests, the presence of Malaria and Anemia parasite can be detected automatic parasite detection has based on color histograms using RBC. Also in our proposed work, Leukemia can be detected on the basis of white blood cell count. In a diagnosis scenario in this study we have proposed a solution for the parasite detection problem by using image preprocessing techniques and image thresholding. It consists of following stages:

1. Image Acquisition
2. Preprocessing
3. Thresholding
4. Edge Detection
5. RBC Counting
6. RBC Extraction
7. WBC Count
8. Approximation

System architecture used for Malaria, Anemia and Leukemia parasite detection involves following steps: gray scale image conversion, filter image, threshold image, edge detection algorithm, RBC counting and extraction technique, WBC count and finally appropriate result i.e. malaria, anemia and leukemia detection result.

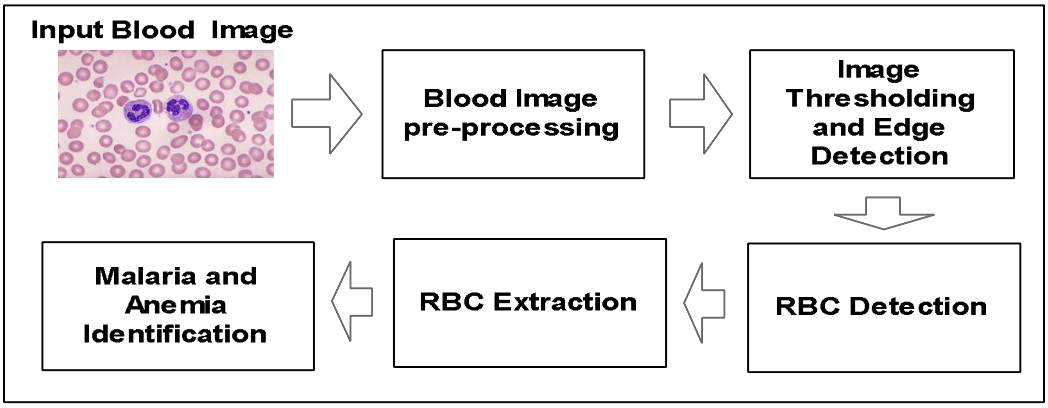

Fig1: System Architecture.

A. Image Preprocessing (Grayscale, Thresholding and Edge Detection):

The purpose of pre-processing is to remove unwanted objects and noise from the image to facilitate image segmentation into meaningful regions. The steps required to carry out image pre-processing were implemented on low resolution images are as follows: i) Load colored (RGB) or gray scale image, the colored image is converted to gray scale image. ii) After that remove the noise of given image for further processing. iii) Then threshold the given image i.e. it convert the black portion dark and white portion bright. iv) Then detect the edges of given threshold image by using canny edge detection technique. The common way described in the literature is to use edge detection algorithms. Edge detection or boundary detection algorithm is use to detect the exact edges of image.

B. RBC Counting and Extraction

In the analysis of automatic classification of Malaria and Anemia l parasite procedures, the most important and difficult part is extraction of Malaria and Anemia parasite infected blood cells from the background and other cells because the blood cells are often overlaid with each other and is the basis of quantitative analysis of its deformability and hence its filterability. Cell shapes, light variation and noise are the other factors that make detection a difficult task. Accurate detection allows fruitful result in sub-sequent levels. Two different threshold values are determined form these detection and extraction of blood cells that are used to identify the final appropriate result. We use the 164 threshold value for the counting of RBC's from the given input blood image and also use 64 threshold value to extract the exact infected RBC's from an image. We also use the bounding box to set the box on detected RBC's for counting the total number of RBC's.

C. WBC Count

In this step we consider the threshold value for detection of WBC in blood image. Threshold values are determined form these detection and extraction of blood cells that are used to identify the final appropriate result of WBC.

D. Approximation

Finally, if the infected RBC's are found in blood image then we shows the result that the given blood sample is malaria infected. We also find the anemia i.e. in given blood image if the counted RBC's are less than 500 then we say that the given blood sample is anemia infected.

The result of the presence of leukemia or not on the basis of white blood cell count and can identify it is based on count of WBC. The identification can be done as shown below.

- < 1700-**leukopenia**
- 1700–3500 **- no leukemia**
- >3500-**leukemia**

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IV. CONCLUSION

This works curbs the human error while detecting the presence of Malaria, Anemia and Leukemia parasites in the blood sample by using image processing and automation. We achieved this goal using Image processing techniques, edge detection technique to detect Malaria and Anemia parasites in images. Anemia is a condition in which a person has a lower than the normal number of red blood cells or hemoglobin in their blood. Also the Malaria and Anemia disease detection we set the Threshold values of counting and extraction of RBC are 164 and 64 resp. Anemia identification we use 500 cells limit, i.e. if our RBC count is less than 500 RBC Cells then the persons suffers from Anemia otherwise the person is healthy. Also in our proposed work, Leukemia can be detected on the basis of white blood cell count.

The system in a robust manner so that it is unaffected by the exceptional conditions and achieved high percentages of sensitivity, specificity, approximation. And the extraction of red blood cells achieves a reliable performance and the actual classification of infected cells.

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