



# A Novel Method of Automated Malaria Parasite Detection Using Android Mobile Phone

Swati Mali, Ashwini More, Yogita Nagmal, Prof. S. T. Khot

Swati Mali, Electronics & Telecommunication, BVCOEW, Pune, Maharashtra, India

[swatidm123@gmail.com](mailto:swatidm123@gmail.com)

Ashwini More, Electronics & Telecommunication, BVCOEW, Pune, Maharashtra, India

[ashwinismore1996@gmail.com](mailto:ashwinismore1996@gmail.com)

Yogita Nagmal, Electronics & Telecommunication, BVCOEW, Pune, Maharashtra, India

[yogitadnagmal12@gmail.com](mailto:yogitadnagmal12@gmail.com)

Prof. S. T. Khot, Electronics & Telecommunication, BVCOEW, Pune, Maharashtra, India

[khotst@gmail.com](mailto:khotst@gmail.com)

## Abstract

In this paper, propose a novel method to identify and detecting the presence of malaria parasites in the human blood smear images which caused by Plasmodium parasite. This paper also provide the information about the identify object from the blood sample image which is Red blood cell with their location in blood sample image also identifies the parasites in the infected RBC. The developed application is based on novel Annular Ring Ratio Method which is already implemented, tested and validated in MATLAB. The developed application also recognizes the different life stages of the parasites. The method use basic knowledge on cell structure on the components due to the samples and detects the RBC in the image.

**Keyword:** Malaria, RBC, WBC, Annular Ring Ratio Method, Morphological operation, Android Platform.

## 1. INTRODUCTION

Malaria is one of the substantially tropical diseases in the world causing wide spread Sufferings and deaths in the developing countries. Malaria is a deadly disease and the recent survey by the World Health Organization (WHO) has estimated that malaria causes over 200 to 300 million clinical cases of fever annually each year resulting in 1.5 to 2.7 million deaths [1][2]. The diagnosis of the disease requires powerful and very expensive tools which is unavailable for the poorest countries of the world, where often the disease is endemic.

Microscopic malaria detection process is, by far, consider the most effective diagnostic method, but it is highly time-consuming and labor intensive sample trained and experienced technicians or Pathologists are needed. By digitalizing the approach will reduce the time taken for screening the disease as well as will improve the

consistency in detection process. This study research the use and application of digital image processing for detecting malaria parasites using microscopic blood sample image an efficient method is proposed for parasite detection based on color based pixel discrimination technique and Segmentation operation.

The aim of this paper is to propose a fully automated image differentiate system to positively identification of malaria parasites present in blood sample image. In this paper, describe an unsupervised approach in which color and segmentation based algorithms are put together to formulas an algorithm for parasite detection from the blood sample image.in this system, a reliable automated Android based diagnostic platform, without any expert intervention for the effective treatment and eradication of the deadly disease, which can be deployed in all the Android based mobile phones and tablets.

## 2. PROPOSED SYSTEM

In this paper, the developed algorithm will be helpful in the area where the expert in microscopic analysis may not be available. The effort of the algorithm is to identify the presence of parasite at any stage. One of the parasites grows in the human body for 7 to 8 days without any Symptoms. So if this algorithm is incorporated in routine tests, the presence of malaria parasite can be detected Automatic parasite detection has based on color histograms. In a diagnosis structure in this study provide a solution for the infected parasite detection problem with two different classifications. The design system is essentially an Image classification problem, and thus takes the form of a standard pattern identification and classification system. It consists of five different stages:

1. Image Acquisition (Done using mobile Camera)
2. RBC Extraction
3. Edge Detection
4. RBC Counting
5. Thresholding
6. Parasite extraction

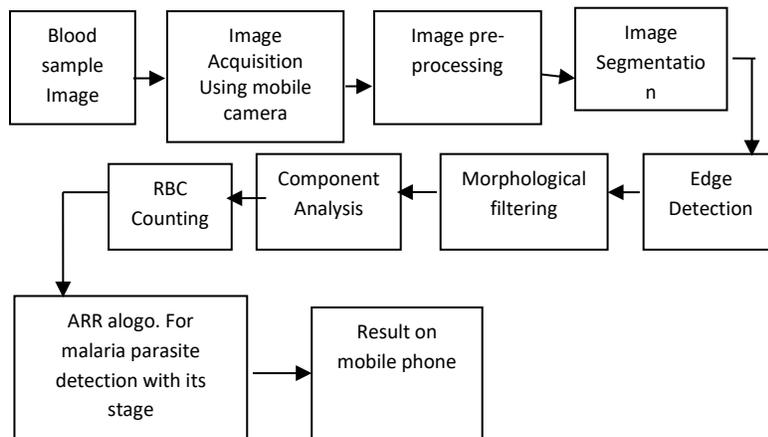


Fig.1: Block Diagram for malaria detection using mobile phone

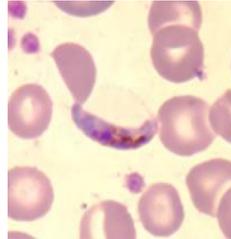
In the given system to detect the whether the person is suffering from malaria or not. In addition it detects the life stage of malaria.

## **2.1 Blood sample image:**

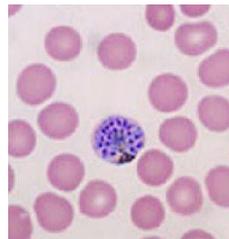
There are four different categories of malaria based on different blood sample images. Those are the *P. falciparum*, *P. vivax*, *P. malariae*, and *P. ovale*. Here to taking different blood sample images for analysis purpose for detecting the infected blood cells from blood sample image, which causes by the malaria parasites.



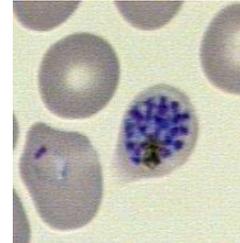
P. Vivax



P. Falcipuram



P. Malarie



P. Ovale

Fig 2: Examples of malaria parasite in the human blood

## **2.2 Image Acquisition:**

All the blood samples images collected from diagnostic center and internet. The Collected images are acquired from a USB microscope which is connected to a computer through the USB port. It is a low-powered digital microscope and is widely available at low cost for use at Diagnostic center and hospital because of the range of the cost is varies from hundred to thousand. In this processing method digital image is capturing by using the mobile camera. These processing method digital images use to improve its quality.

## **2.3 Image segmentation:**

In image segmentation process, partitions image into its constituent segments or object this method called as segmentation of the image. In malaria detection process, it includes partitioning the image into foreground region with the aim to isolate the RBC & background region with the plasma from the blood sample image. Blood cell is the objects which separating from background we are using the algorithm for recognize the blood cell from blood sample image.

## **2.4 Edge detection:**

In edge detection method detect the boundary of the present object in that the image. Mostly the shape information is given to the image which helps to enclose all the edges. In these processes each image consists of high frequency content in an image. Therefore high pass mask is used for detecting edges of blood image.

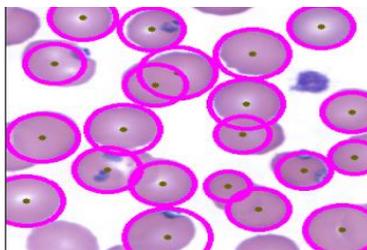


Fig 3: Boundary detection

### **2.5 Morphological operation:**

Morphological image processing is an area of non-linear image processing, which deals with geometrical structure of an image. Morphological filters have been used as an edge detector, in image compression and for feature extraction. Morphological filtering operation, in which processing method involves the dilation followed by erosion using different structuring element (SE). A concentric ring SE for dilation and disk shaped SE for erosion. So that the erosion expands the size of darker, object in a lighter background and will be performed in order to restore the dilated RBC.

### **2.6 Component Analysis:**

It is a task of finding a given object in an image. In the component analysis technique analyze the whether it is RBC, WBC, or Plasma which presence in the blood sample image. It will categorize the blood cell into the RBC and infected RBC, which will present in the blood cell image. For the component analysis, uses a csv algorithm to detect the blood cell in the blood sample image with their types of malaria. In RBC blood cell, it will divide into the two parts that are normal RBC and infected RBC.

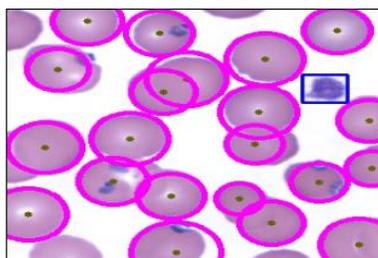


Fig 4: Infected cell detection

### **2.7 RBC Counting:**

In the RBC counting method, calculate number of RBC, which will be presented in the blood sample image. By using, the method knowing the how many RBCs are infected and how many RBCs are normal which presented in the blood sample image. Infected RBCs are indicating whether patient suffering the malaria or not. For the analysis purpose, it is necessary to know the number of infected RBC, which presented in blood sample image.

### **2.8 ARR Algorithm:**

Annular Ring Ratio transforms which is used to detect peaks of intensity at the center of each RBC in the image. A peak detection algorithm will use to determine the coordinates of each RBC. Using ARR transform method calculates the ratio of outer intensity to the inner intensity by means of an annular ring-structuring element.

The average intensity of outer side of the annular ring is the  $I_o$  & average of the inner disk intensity is  $I_i$ . Annular Ring Ratio given as the below,

$$RR = \max\left[\frac{I_o}{I_i} - 1, 0\right] \quad (1)$$

The location of this peaks are sub-sequent found by searching the regional maxima in the ARR transformed image using circular structuring of element. In order to differentiate as well as categories in the infected RBCs & total normal RBCs of an image. The mean intensity of the region which connected to each pixel of the closed image at location provided by the ARR transform is calculated.

**2.9 Result on mobile phone:**

Result of the malaria detection is display on the mobile phone. The implementation of the application on android operating system needs specialist software for Android & Java Development Tool. Designing the application for mobile phone here to use android studio 2.3.3 is used. Android-based mobile phone implementation Android mobile phone requirement of android version 2.2 is essential.

Display the result of malaria on the mobile phone in terms of No. of RBC, No. of WBC, No. of Infected RBC, and Life Stage of malaria, type of malaria. It gives the message in terms of malaria is detected if patient suffering from malaria, if not then it will display malaria is not detected.

**3. EXPERIMENTAL RESULT**

The method was experimented in Net bin on a set of images with a range of variations in color as well as lightning and other imaging condition. The resolution of the image is modified and reduced to speed up the performance. For processing purpose, we use color image i.e. the RGB and HSI model. This image is bitmap file format & size of file format is 14 byte, which is specially used for graphical user interface. For image segmentation process, image thresholding and edge segmentation method for separating blood cell from each other.

Area granulometry was applied on these entire images to acquire the cell size and radius of cell. By using boundary detection method and detecting nuclei of the blood cell, categories foreground & background blood sample image. Detect infected parasite in square form. It gives result positive & Negative form. In addition, it counts no. of cells & no. of infected cells from blood sample image. It will detect types & stages of malaria and the result will display in percentage on mobile phone. By using Android Studio, create an application for mobile phone to display the result.

A performance measurement of the two parasite detection methods were conducted on sets of images carrying RBC. The accuracy of the system is defined to be measure of True positive (TP-positive result for a positive sample), True negative (TN-negative result for a negative sample), False positive (FP-Positive result for a negative sample), and False negative (FN-negative result for a positive sample) and it is given as:

$$ACC = \frac{TP+TN}{TP+TN+FP+FN} \quad (2)$$

The outcomes of the performance measurement estimate the sensitivity, positive prediction value (PPV) and Negative prediction measurement of the two parasite identification technique.

TABLE 1. Confusion matrix of test data

parameter	Parasite Class	Non-parasite Class
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Parasite Class	34	14
Non-parasite Class	6	20

#### **4. CONCLUSION**

An efficient and reliable mobile phone application to diagnosis malaria has implemented. Some improvements have done such as the layout of interface for different screen sizes or the use of captured high-resolution image. We remove the noise, separate blood cell using the image segmentation method and detecting the discontinuities in brightness using edge detection method in the blood cell image. Result will display on the Android mobile phone after taking the image from the mobile gallery in less than 60 sec.

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