# MALARIA DETECTION USING IMAGE PROCESSING

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*Abstract:* Malaria is a serious disease which is caused by the parasite of the genus plasmodium. It poses a global problem and warrants an automatic evaluation process because conventional microscopy which is considered the gold standard has proven to be inefficient and its results are hard to store and reproduce. In conventional microscopy the blood of a malaria infected patient is placed in a slide and is observed under a microscope to count the number of infected RBC. This is a time consuming and tiring process even with the involvement of an expert technician. In this study we propose a computerised diagnosis which will help in immediate detection of the disease so that proper treatment can be provided to the malaria patient. We propose the usage of image processing techniques to automate the process of parasite detection in Giemsa stained blood samples of patients. The proposed system is robust and it is unaffected by exceptional circumstances and achieves high percentages of sensitivity, specificity, positive prediction and negative prediction values.

*Keywords* - **Malaria, Image Processing, Automatic disease detection.**

## I. Introduction

Malaria is a life-threatening disease caused by parasites that are transmitted to people through the bites of infected female Anopheles mosquitoes. It is preventable and curable. According to the latest World Malaria Report, released in November 2017, there were 216 million cases of malaria in 2016, up from 211 million cases in 2015. The estimated number of malaria deaths stood at 445 000 in 2016, a similar number to the previous year (446 000). The African region continues to share a high percentage of the global malaria burden. Taking the number of cases and current diagnostic methods into consideration it is obvious that a rapid and accurate diagnosis which enables prompt treatment is an essential requirement to control the disease.

There are various techniques to diagnose malaria through manual microscopy. These techniques are considered to be time consuming and lead to late diagnosis because there are numerous steps required and are prone to human error. This results in wrong diagnosis, sometimes even in the hands of an experienced technician. The methods which we propose in this study are robust, unsupervised and sensitive malaria screening methods. We consider digital image processing techniques that are applied to images of Giemsa stained blood samples. The advantage of using digital image processing is its ability to carry out the diagnosis in less time, providing high quality of sensitivity and also reduces cases of false negativity. In this paper we present a new window of image processing techniques for diagnosis and qualifications of plasmodium parasites in blood smear. The efficiency of these techniques depends on factors like quality of microscope and images. The patient is also assumed to have a healthy blood count. Table 1 shows the normal blood count by gender.

| Blood Cell Type | Gender | |
| --- | --- | --- |
| | Men | Women |
| RBC | 4.5-6.0 million/microlitre | 4.0-5.0 million/microlitre |
| WBC | 4.5-11 thousand/microlitre | 4.5-11 thousand/microlitre |
| Platelet | 150-450 thousand/microlitre | 150-450 thousand/microlitre |
| Hematocrit | 42%-50% | 36% to 45% |
| Hemoglobin | 14-17 grams/100 millilitres | 12-15 grams/100 millilitres |

## II. LITERATURE SURVEY

After exploration the available literature in this area we observed that there have been many ideas put forth in order to achieve the system. The following papers were consulted and were the driving force for our ideas.

In [1] **"Detection of malaria parasites using digital image processing",** The method made use of the intensity features of Plasmodium parasites and erythrocytes. Images of infected and non-infected erythrocytes were acquired, pre-processed, relevant features extracted from them and eventually diagnosis was made based on the features extracted from the images. A set of features based on intensity have been proposed, and the performance of these features on the red blood cell samples from the created database have been evaluated using an artificial neural network (ANN) classifier.

In [2] **"Detection of malaria parasite in Giemsa blood sample using image processing"**, The proposed system model is implemented by using two segmentation that are HSV segmentation and watershed segmentation. The result of both the segmentations are mapped so that all the malarial parasites can be counted. This is done to improve accuracy.

In [3] **"Detection of malarial parasite in blood using Image Processing"**, The design takes the form of a standard pattern recognition and classification system. The system architecture of malaria parasite detection includes grey scale image conversion, thresholding, thinning labelling algorithm. To detect the infected cells, colour range and image segmentation techniques are there from Giemsa stained peripheral blood samples.

In [4] **"Colour image segmentation approach for detection of malaria parasite using various colour models and k-means clustering"**, This paper shows that the detection of malaria parasite can be also done through colour image segmentation which can be further applied on malaria images of P.vivax species. The use of partial contrast stretching is introduced here in order to obtain segmented RBC infected within the malaria parasite. After that an unsupervised segmentation technique is used which is known as k-means clustering. It segments the infected cell from background different colour components of RCB, HSI and C-Y colour modes needs to be checked to identify colour components.

In [5] **"Automatic diagnosis of malaria based on complete circle-ellipse fitting search algorithm"**, Thin blood smears are used in this study and is mainly based on curve fitting to detect the infected cells in the blood smear. The method is composed of six phases- stain object extraction step, preprocessing phase which uses nonlinear diffusion filtering followed by detection of parasite nucleus from the result of previous step according to the image intensity, fourth step is to introduce an complete search process in which circle search step in defines the direction and initial points for direct least square ellipse fitting algorithm, further more ellipse searching process is applied finally a series of decision rules on the presence of infected cells in the blood smear.

In [6] **"Computer automation for malaria parasite detection using Linear Programming"**, Mathematical modeling technique is used by means of LP as an efficient tool to solve problems related to malaria parasites problems related to malaria diagnosis through microscopy imaging problems.
Two applications are approached:
1. Formulation of LP model based on given data.
2. Solving and displaying the result using graphical method approach for detecting
infectious cells.
The application mainly consists of developing a linear mathematical model from the collected information and in addition to it, the problem is solved by graphical approach. However, the system is complex and adds a drawback of delay
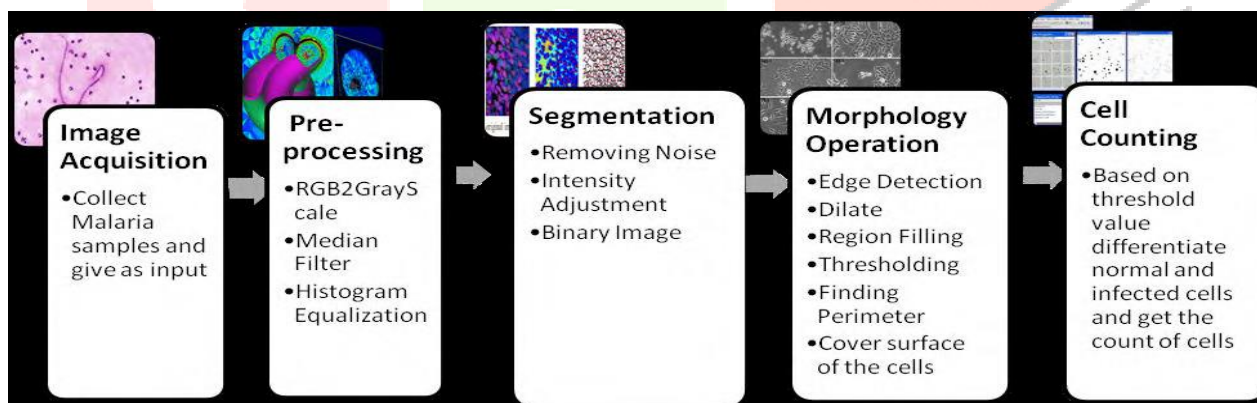
## III. METHODOLODY



Fig 1.

We propose an economical and efficient method to detect parasites. The first step is to acquire images of Giemsa stained blood smears. The center of disease control and research provides an excellent gallery of images for us to use. In the pre-processing stage we convert an RGB image to grayscale in order to speed up execution time. Then in order to remove noise and adjust the contrast we use median filtering and adaptive histogram equalisation respectively. Chan-Vese et al [9,10] proposed energy minimization of the image to detect edges of objects embedded within an image. We use this algorithm to separate background and foreground of the image. Then we perform various morphological operations like dilation, edge detection and holes filling. We use algorithms like flood-filling in order to smoothen the images. The final RBC and parasite extraction is performed using threshold values and the diagnosis is given based on the parasite count. Fig 1. and Fig 2. show the steps we use in our algorithm.
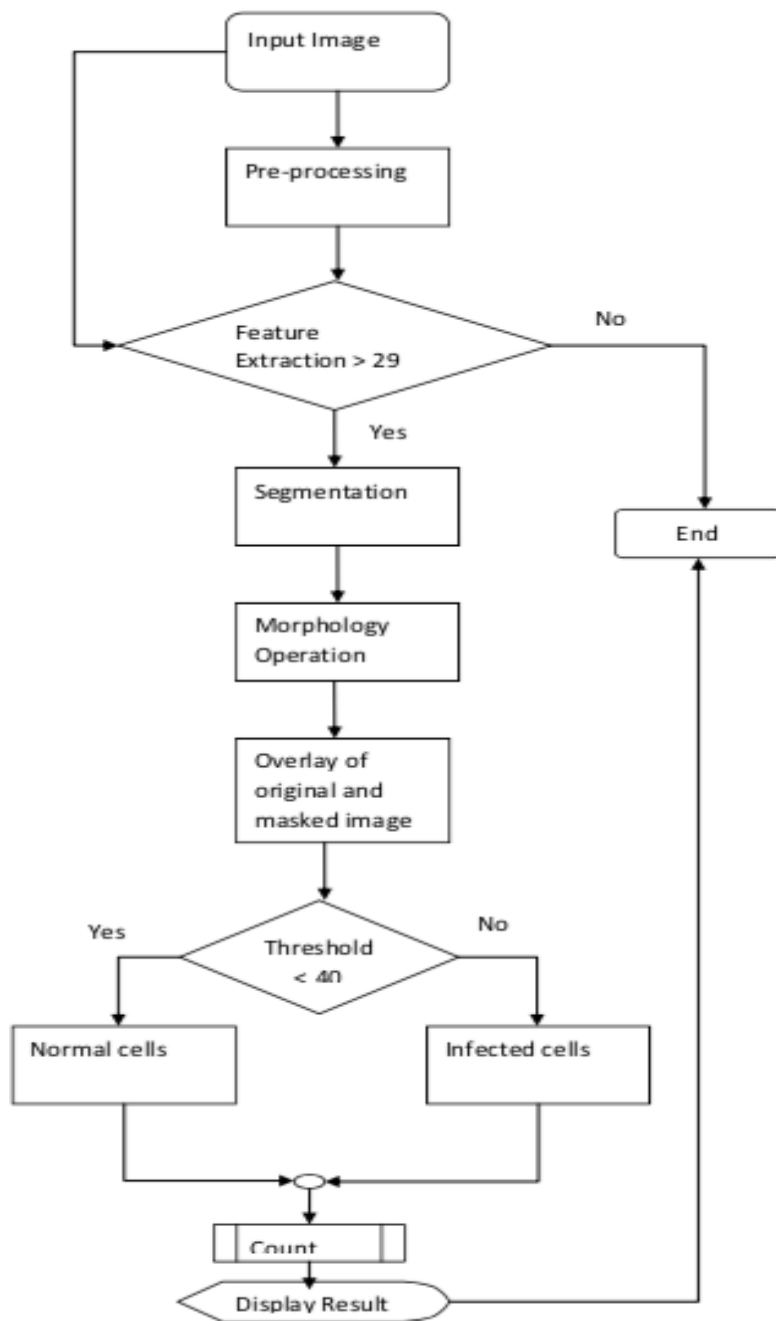
## IV. FLOWCHART



Fig 2.

## V. SOFTWARE REQUIRMENTS

1. Python 3.5 (A General-Purpose Programming Language)
2. OpenCV (python library for computer vision applications)
3. Scikit-image

## VI. RESULTS AND DISCUSSION

The experiment was conducted by collecting blood samples of patients suffering from malaria. Totally 8 images were taken from different blood samples. The images were used as raw data for malaria parasite count. The results of the sample images is reported in Table 2. We performed the experiment using open source libraries for python such as OpenCV and Scikit-image. These libraries provide implementations of the algorithms used and are very powerful. They are also very light-weight and can be used in small devices and remove the requirement of having a full-fledged computer that needs to be operated by a technician.

| Image number | Manual RBC | IP approach RBC count | IP approach maleria | Manual count |
|---|---|---|---|---|
| 1st image | 34 | 33 | 4 | 4 |
| 2nd image | 33 | 31 | 5 | 5 |
| 3rd image | 34 | 32 | 6 | 7 |
| 4th image | 41 | 38 | 0 | 0 |
| 5th image | 63 | 56 | 9 | 10 |
| 6th image | 33 | 32 | 1 | 1 |
| 7th image | 54 | 50 | 1 | 1 |
| 8th image | 40 | 40 | 2 | 2 |

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