

# Malaria Parasites Concentration Determination Using Digital Image Processing: A Review

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**Abstract** - Malaria is a severe infectious disease caused by female *Anopheles mosquito*. In 2016 alone 216 million cases of malaria occurred worldwide and 445000 died. So treatment should be initiated as soon as possible. Apart from species of infecting parasite, concentration of malaria parasite decides the course of proper treatment. Patients with severe malaria need intensive parental care until the parasite density falls below 1% and they can tolerate oral therapy. If parasitemia exceeds 10% then exchange transfusion may be necessary. A general structure of image processing is used to find the concentration of malaria parasite. The thin blood smear images of Giesma stained are processed. The system uses intensity as a feature to find out the malaria parasite. The image is preprocessed and binarized and segmented to find the circles of interest where infected erythrocytes are found. This study investigates the use and application of Digital Image Processing for detecting malaria parasite and determining its concentration using microscopic color images.

**Key Words:** Malaria, parasitemia, Exchange transfusion, blood smear, Giesma stained, Digital Image Processing.

## 1. INTRODUCTION

Malaria is a parasitic infectious disease caused by being bitten by female *Anopheles mosquito* which is infected with it. There are approximately 430 types of species of *Anopheles mosquito* out of which 30 to 40 are the carrier of malaria parasite. Five species of parasite within genus *Plasmodium* are the agents for malaria.

In 2016 total 216 million cases of malaria occurred worldwide and 445000 people died mostly children and pregnant women. Most affected areas are tropical and subtropical regions which include Africa and South Asia. So malaria can be severe and is potentially fatal. Hence early and rapid diagnosis of malaria is must and treatment should be started as soon as possible. Severe malaria patients need special care and accurate treatment until malaria parasite density falls below 1% and patients will be able to tolerate oral therapy. If malaria parasite density exceeds 10% or patient is showing any complications then blood transfusion may be necessary. So determining the parasitemia is of high importance, as high malaria parasite density patients do not properly respond to oral treatment.

There are so many numbers of vision studies address the automated diagnosis of malaria but none of the work provides the concentration of malaria parasites in blood images using digital image processing. So proposed system not only detects the malaria parasite in the blood but also determines the concentration of malaria parasite in blood smear image.

## 2. RELATED WORK

Manual microscopy is carried out by examining thin blood films on slides under the microscope and reporting the percentage of parasitaemia (i.e. a number of infected red blood cells (iRBCs) for over 100 microscopic fields). Microscopists also need to identify parasite morphology by various life cycle stages for speciation, described in The WHO practical microscopy guide.

[1]. Five species of the parasite within genus *Plasmodium* which are the agents for malaria are *P.vivax*, *P.falciparum*, *P.ovale*, *P.malariae*, *P.Knowlesi*.

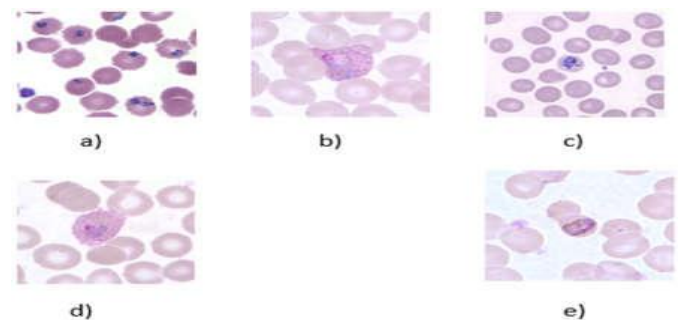


Fig.1. Species of Malaria parasite, (a) *Plasmodium Falciparum* (b) *P. Vivax* (c) *P. Knowlesi* (d) *P.ovale* (e) *P. Malaria*

When a female *Anopheles mosquito* penetrates human skin to obtain a blood meal it injects saliva mixed with anticoagulant. If the mosquito is infected with *Plasmodium* it will also inject elongated sporozoites asexual cells into the blood cells of its victim. These sporozoites travel to the liver and they enter the liver cell and rapidly divide asexually. This asexual division which is called schizogony generates the next life cycle form called merozoites. The released merozoites invade other liver cells and enter the host's bloodstream where they invade erythrocytes. Once inside the erythrocytes, merozoites begin to enlarge as a unit

nuclear cell termed ring trophozoites. Trophozoite nucleus then divides asexually to produce a schizont which contains several nuclei. The schizonts then divide and produce mono nucleated merozoites. The erythrocytes then rupture and release toxins throughout the body of the host bringing about the well-known cycle of fever and chills which are characteristics of malaria.

Plasmodium enters a sexual phase when some merozoites in the erythrocytes develop into gametocytes cells capable of producing both male and female gametes. Erythrocytes containing gametocytes do not rupture. Gametocytes are incapable of producing gametes within the human host. And do so only when they are extracted from the infected human host by a mosquito. Within the gut of the mosquito, gametocytes form male and female gametes. The resultant deployed zygotes develop within the mosquito's intestinal walls and ultimately differentiate into the oocyte. Within the oocyst repeated division takes place producing a large number of sporozoites. These sporozoites migrate to salivary glands of the mosquito and from there are injected by the mosquito into the bloodstream of the human. Thus life cycle of the malaria parasites starts again.

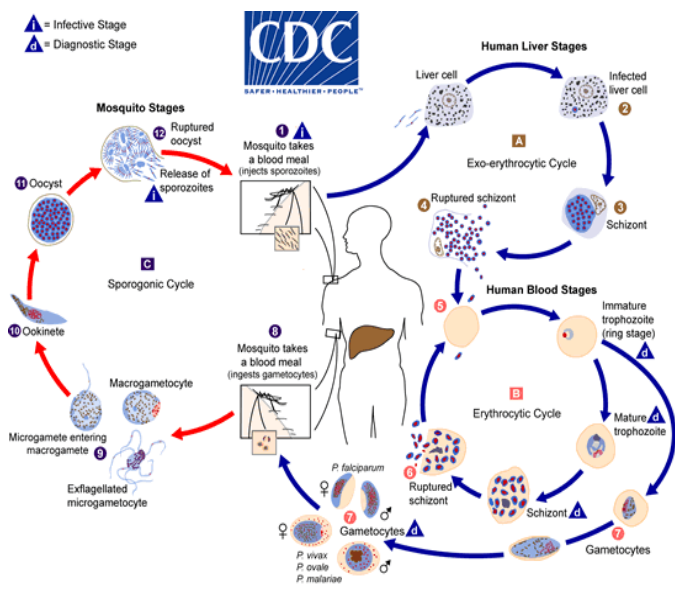


Fig.1. Life Cycle of Malaria parasite

[2] System detects the presence of malaria parasite. The images used are processed and certain feature extracted. The neural network which has been trained with back program algorithm is used. In addition, the graphical user interface has been designed to facilitate the use of the system. The accuracy obtained as comparing results of experts is 99.68%.

[3] An efficient algorithm is developed for detecting the disease malaria blood images in this computer system is faster and helps in precise diagnosis. The segmentation of parasite is performed using Q layer of YIQ colour space in order to detect malaria. The result in categorizing the blood image into malaria or non-malaria is obtained with an

accuracy of 97.5%. The developed classification tool is promising and can be useful in the rural areas for screening the malaria patients where there will be lack of trained technicians.

Author [4] presents a technique which implements image binarization using Poisson's distribution based minimum error thresholding followed by the morphological opening for refinement. Used Gobar filter as frequency and orientation representation of Gobar filter are same as that of the human visual system. The technique uses Support Vector Machine (SVM) classifier which gave an accuracy of 93.33%.

[5] Author proposed a technique based on an electronic recording of holograms and their numerical reconstruction by stimulating diffraction. So here they described the digital holographic microscopy (DHIM) with focusing on automatic identification of malaria-infected red blood cell (RBCs)

[6] The author used morphological method for malaria parasite detection in blood smear image. Dimensions and colour are the parameters considered to identify parasite. Automatic thresholding based on morphological approach has been used. Watershed algorithm is combined with morphological operators to perform segmentation.

In this paper [7] approach template is used for detection of RBC. Parasites are detected using variance based technique. From grey scale image and second approach is based on colour co-occurrence matrix.

### 3. CONCLUSIONS

Pathologists manually detect malaria parasite using microscopes which can lead to human error. Also, these results are hard to reproduce whenever necessary. Different papers proposed different techniques to detect malaria parasite in blood smear image. This review paper also focuses on detection of malaria parasite using digital image processing. Automatic identification of malaria parasite eliminates the human error and also reduces the time for processing. And also such results can be reproduced easily whenever needed.

### REFERENCES

- [1] WHO. World malaria report 2017. World Health Organization, Geneva; 2017. Tech Reports.
- [2] Ahmedelmubarak Basir; Zeinab A. Mustafa; Islah Abdhameid; Rimaz Ibrahim, "Detection of malaria parasite using digital image processing", 2017 International Conference on Communication, Control and Electronics Engineering (ICCCCEE)
- [3] N.R. Shet and N.Sampathila, "An Image Processing Approach for Screening of Malaria", Canar. Eng. Coll. Mangalore, pp. 395-399, 2015.

- [4] M. S. Suryawanshi and P. V. V Dixit, "Comparative Study of Malaria Parasite Detection using Euclidean Distance Classifier & SVM," vol. 2,no. 11, pp. 2994–2997, 2013.
- [5] A. Anand, V.K. Chhaniwal, N.R. Patel,and B. Javidi, "Automatic identification of malaria-infected RBC with digital holographic microscopy using correlation algorithms," IEEE Photonic J., Vol. 4, no.5,pp. 1456-1464, 2012.
- [6] C.Di Ruberto, A. Dempster, S.Khan, and B. Jarra, "Automatic thresholding of infected blood images using granulometry and regional extrema", 441-444, 2000 IEEE
- [7] Halim S,Bretschneider T.R,Yikun Li,Preiser P.R., "Estimating malaria parasitaemia from blood smear images", proceedings of the 9th international conference on control, automation, robotics and vision, PP.1-6,Dec.2006.