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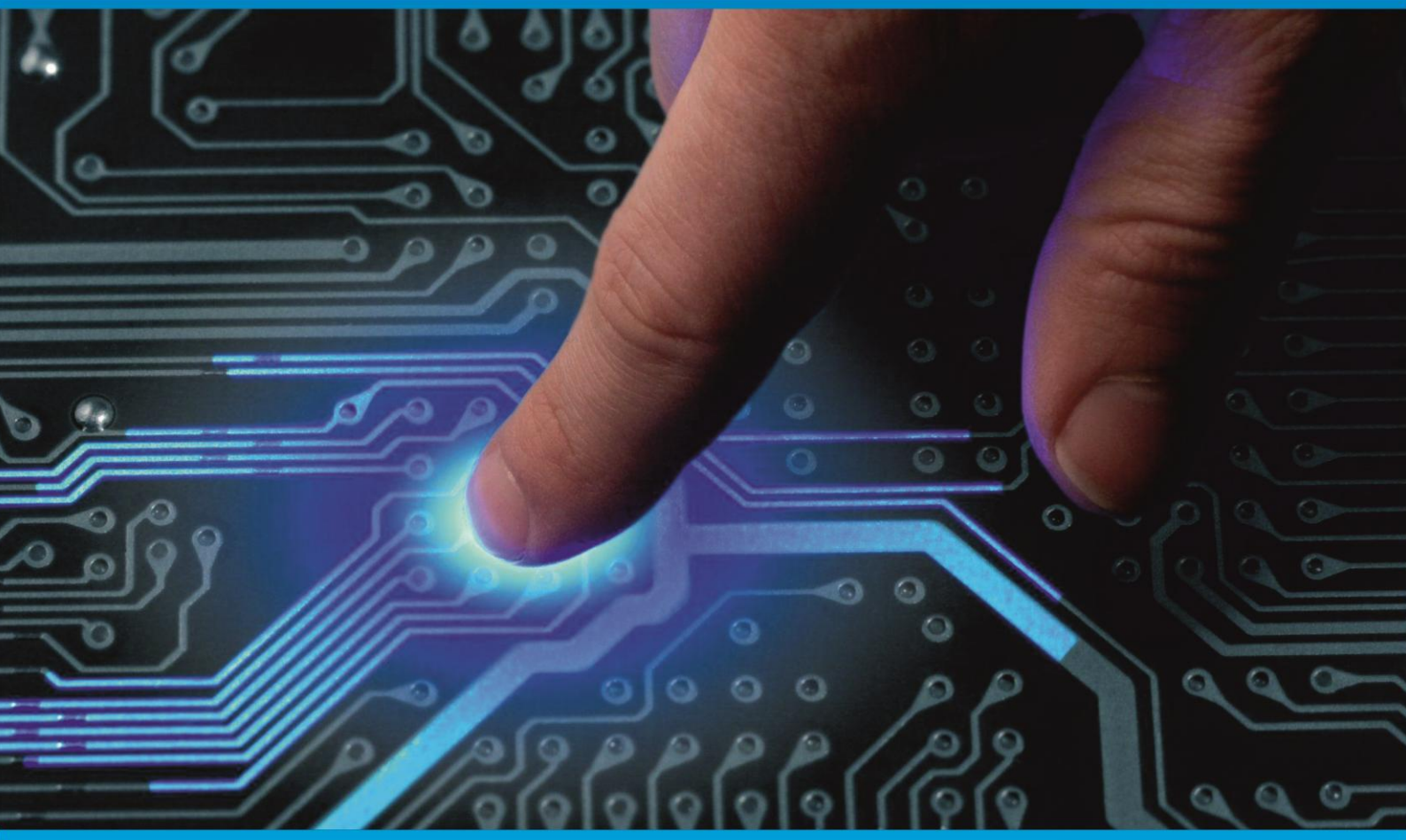

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Classification of Life Stages of Malaria Parasite using Image Segmentation & Processing

Mark Isidore Nicholas Alexander, Arun

P.G. Student, Dept. of Computer Science, St Joseph's College, Bangalore, India

Assistant Professor, Dept. of Computer Science, St Joseph's College, Bangalore, India

ABSTRACT: Malaria is a vector-borne disease commonly occurring in the equatorial region. Even after decades malaria today has a high mortality rate. This happens due to late diagnosis, by the time the patient is diagnosed the disease is spread to the entire body. To prevent people from getting affected by malaria, the patients should be diagnosed in the early stages and accurately. This paper presents an automatic method for the diagnosis of plasmodium within the blood images. Image segmentation and processing techniques are used for the diagnosis of the plasmodium and to detect their stages. The diagnosis is completed using features like statistical and texture features of the plasmodium within the blood images. This paper gives a comparison of the texture-based features individually used and is employed within the group together. The comparison is made by considering the accuracy, sensitivity and specificity of the features for the same images in the database.

KEYWORDS: Plasmodium, life cycle classification, segmentation, processing.

I. INTRODUCTION

The host is an infected female *Anopheles* mosquito, which spreads the plasmodium. The highly occurred vector-borne disease in the equatorial region is Malaria. As to the World Health Organization (WHO) 2020,according to the latest World malaria report, released on 30 November 2020, there were 229 million cases of malaria in 2019 compared to 228 million cases in 2018. The estimated number of malaria deaths stood at 409000 in 2019, compared with 411000 deaths in 2018. Even though the percentage is reducing, but if a person acquires malaria, the chances of survival are less and can be fatal, until and unless it's diagnosed at an early stage. There has to be a way for saving lives by making early diagnosis and medication. Nowadays in the biomedical fields, almost all disease diagnosis methods are turning into computerized automatic way. In this paper, diagnosis of the parasite in the blood images are made digital using the proposed method which works with image processing.

There are many clinical methods that may be used for malaria diagnosis which is peripheral blood smear (PBS), quantitative buffy coat (QBC), rapid diagnosis test (RDT), Polymerase Chain Reaction (PCR), and Third Harmonic Generation (THG). Among these entire tests, the PBS is used almost everywhere and has limitations of human resistance and it requires time. By automating the system these limitations are overcome. The blood images are processed and then the diagnosis is completed. The major problem in processing the blood images is that the red blood cells (RBC) have to be segmented from the background; a correct separation can help to realize high accuracy in detecting the presence of plasmodium and this helps in classifying the life cycle stages of the malaria parasite. Thethree different stages in which the plasmodium life cycle is differentiated, trophozoites, schizocytes, and gametocytes. Each one of them is characterized by unique features like shape, size, and texture will play an important role in identifying and classifying these stages, using image segmentation. Features are the keyto differentiating and diagnose the parasite stages.

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II. PROPOSED METHOD

The method used for detection the malaria parasite is mainly divided into two parts first as the image recognition and the second as the image classification and parasite estimation.

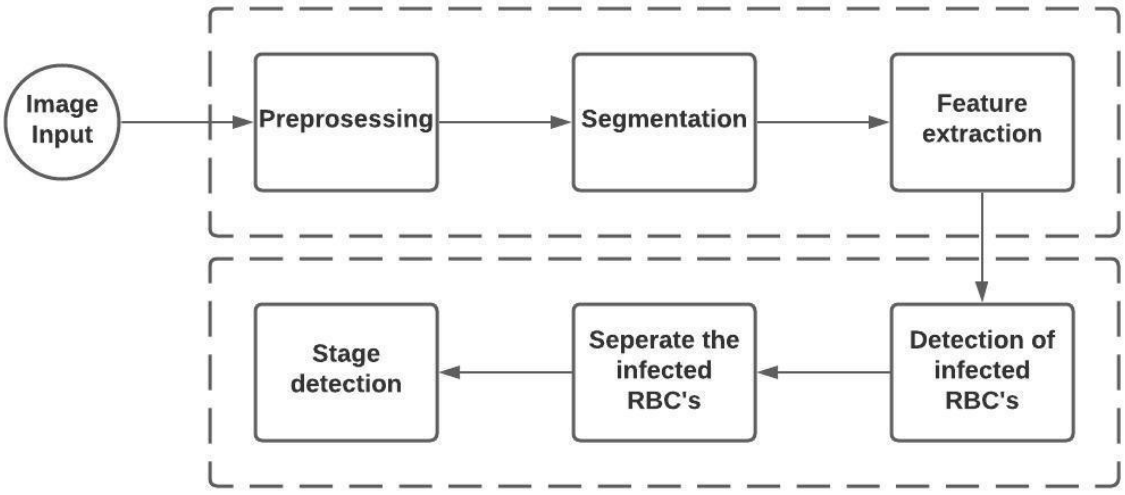

Figure 1: Block Diagram of the proposed method

Algorithm for Preprocessing

Step1: Start

Step2: Create a grey image

Step3: Autothreshholding

Step4: Create a Mask

Step5: Separate the HSV band

Step6: Combining G and V band to create object mask

Step7: Removing unwanted artifacts using open close mask method

Step8: Stop

In the above block diagram, the first three steps consist the basic steps of image segmentation and image processing. The steps are processing, segmentation and feature extraction. While the image classification and detection show us the infected red blood cells and that I called parasitemia. Them the separation and the stage detection are carried out.

In this paper, the malaria images of three stages schizonts, trophozoites and gametocytes stages are captured as images from the blood smears. First, a knowledge base was created using images from the web database like the Centre for Disease Control (CDC) and Prevention and from Public Health Image Library consisting of both sorts of samples parasitic and nonparasitic blood samples. The oil-immersion images are taken from the camera with 100x zoom. Database was created with 100 images from which only 50 images are used for the training stages and the remaining 50 images for the testing stage were used.

Then preprocessing is done to make the images remove noise and other unwanted disturbances so that the image can be processed easily. Initially, all the images are converted into grey images. Then Red, Green, Blue (RGB) plane for the

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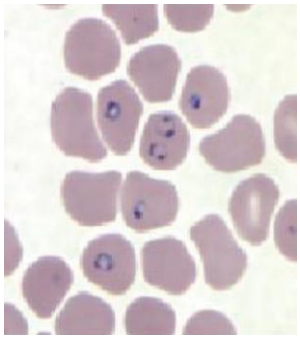
input images so the mask is created for segmentation. Once the RGB plane separation is done the intensity histogram is taken to compared the various intensity and then worked on two key requirements intensity factor and thresholding. Object mask is created on the region of interest of the input image, and that part where the mask is created should have the parasite present there. Considering all the aspects Hue, saturation and value bands are created. When the HSV bands are combined and GV band is obtained and that is names as object mask. Then this object mask is further processed to get a good quality image which has all the RBC and the parasite are clearly seen and finally closing and opening on the object mask are performed to remove unwanted artifacts.

Once all the preprocessing is done segmentation process is carried out on the processed image so the area of interest can be obtained. The malaria parasite affects only the red blood cells, segmentation is done to separate the red blood cells. Once the segmentation is done the result are again processed till the infected red blood cells are identified.

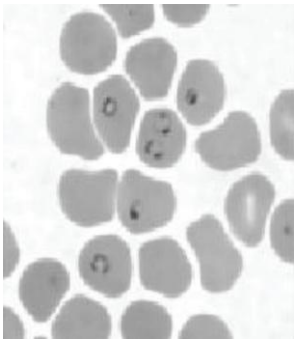
III. EXPERIMENT RESULT

After processing and segmenting the images, this is what it looks like.

Conversion of RGB image to grey scale:

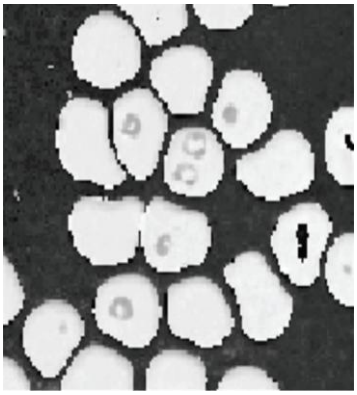


(a) RGB Image

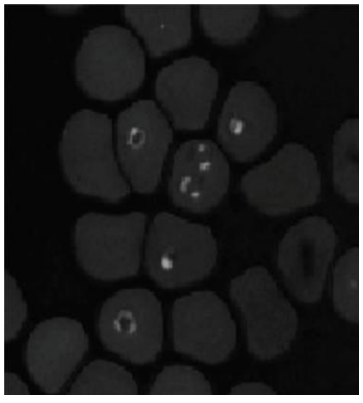


(b) Grey scale

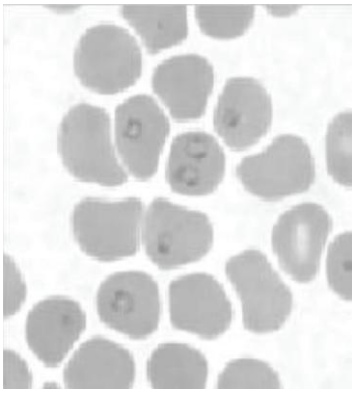
Separate the HSV band:



(a) H band



(b) S band



(c) V band

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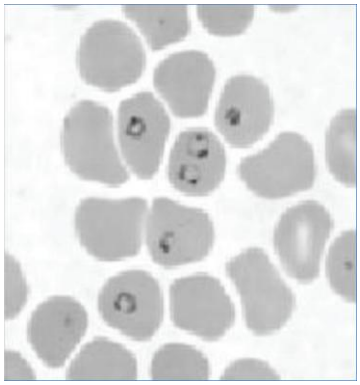
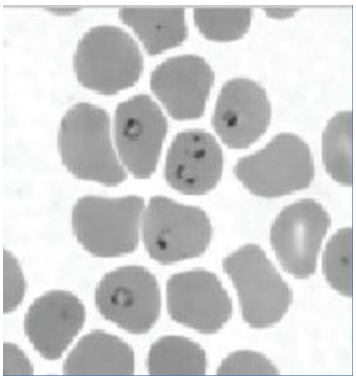
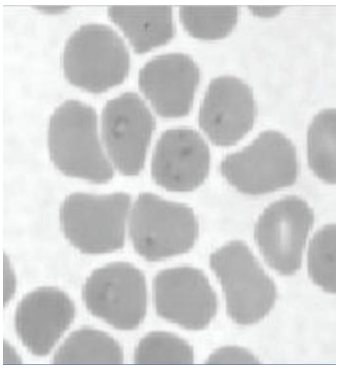
Separate the RGB bands:



(a) R

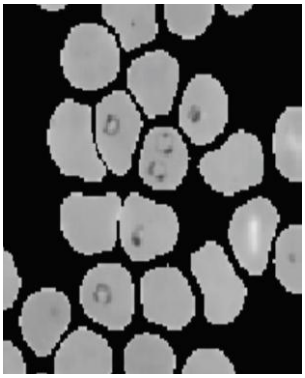


(b) G



(c) B

Converted grey scale image of object mask:



Once the preprocessing and segmentation is competed the next step is the feature extraction. Here feature extraction is performed using statistical and Texture bases features where patterns are obtained to detect the infected RBC.

After the infected RBC are detected, they are separated from the other uninfected RBC. In the end once all the calculations and test are done. The stage of the developing mosquito parasite is determined. Depending on which stage the life cycle is the medical treatment is given to the affected.

IV. RESULTS

The accuracy, sensitivity, and specificity for considering all features together and for individual texture-based features, it can be seen that if all the features are used together, then the high diagnosis accuracy can be achieved. If all the features are used together, the SVM gets trained very efficiently and therefore the classification of the parasitic and nonparasitic samples and therefore the determination of the stage are through with higher accuracy of about 97%. This means the diagnosing of parasite and therefore the detection of the stage is more reliable if all the features are used together. This classification, it gives more accuracy, sensitivity, and specificity up to 90.55%, 85.36%, and 91.66%. The high accuracy achieved by the presented system can be compared with other methods in the literature.

V. CONCLUSION

As the number of individuals infected by malaria in tropical region is high, there's special need of early diagnosis of plasmodium, for its prevention against stepping into next stage and drugs of an individual. This paper has presented automated diagnosis of plasmodium in blood images. The diagnosis is completed by using features like statistical and textural based features which has enhanced the diagnosis accuracy of the presented system. Additionally, the presented method is additionally helpful in detecting stages of plasmodium. The segmentation is completed using watershed

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algorithm using distance transform which counts the overlapped RBC within the blood images. The system achieved high accuracy of 97.7% for automatic diagnosis of plasmodium in blood images.

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