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## Detection of Malaria Parasites with Image Processing Techniques

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**ABSTRACT**-Malaria is caused by a blood parasites named Plasmodium and is a very infectious disease. The gold standard for diagnosing malaria which is conventional microscopy gave insufficient results because of time consuming and difficulty of producing results. In this work, development of stained thin blood smear occurs which is an accurate, rapid and affordable model of malaria diagnosis. This research proposes a detection method of plasmodium parasite at RBC using double thresholding for improving accuracy of detection. Better accuracy is obtained by Classification obtained by SVM than conventional methods.

**KEYWORDS:** Double Thresholding, Segmentation Image Processing Techniques

### I. INTRODUCTION

Malaria is caused by a blood parasites named Plasmodium and is a very infectious disease. According to the World Health Organization statistics, in 2000, it was estimated that there were 262 million cases of malaria globally, leading to 839,000 deaths. By the year 2015, it was estimated that the number of malaria cases had decreased to 214 million, and the number of deaths decreased to 438,000. The second most dangerous after tuberculosis and is malaria which is endemic in areas of Africa, Asia, South America, and to a lesser extent in areas of Middle East and Europe. Malaria is transmitted by the biting of female mosquitoes named anopheles which carry the protozoan parasite of the genus Plasmodium. The genus has mainly 4 species -P.falciparum, P.vivax, P.ovale and P.malariae (There are other species that infect animals) and four life stages: ring trophozoites, trophozoites, schizonts and gametocytes. Plasmodium vivax is the cause of most malaria cases, accounting for around 80% of the total infections in Asia and America. This species causes benign tertian malaria with frequent lapses. The parasitemia of P. vivax is usually not heavy. In blood samples, infected erythrocytes would contain only one trophozoite, and with less than 5% of the cells being infected. In its trophozoite stage, the structure of the parasite is well-defined, having a prominent central vacuole. The cytoplasm is distinguishably blue, while the nucleus red in stained films. An infected erythrocyte would be slightly enlarged and exhibits red granulations called Schuffner's dots. Plasmodium falciparum is most distinguishable for its sickle-shaped gametocyte. This species is the most pathogenic of all species, posing high rate of complications and fatality if left untreated. The trophozoites of this species appear as tiny ring-forms usually attached near the walls of the erythrocytes. Many of the ring-forms have binucleate rings (double chromatin dots). In peripheral blood sample, definitive diagnosis of malaria is done by visual detection and recognition of the parasite in a stained sample of blood through a microscope. Giemsa stain is the common staining technique for malaria diagnosis in thin blood films. If examined through a light microscope, the Plasmodium species, white blood cells (WBC) and platelets or artifacts will appear as saturated dark blue-purplish whereas the red blood cells (RBC) are lightly colorized. However the visual effect of staining varies according to the lighting and imaging conditions. But the manual microscopic diagnosis is having some drawbacks like it is laborious, time consuming and the accuracy depends on the expertise of the microscopist. Hence automating the process is important to provide an accurate, reliable and objective tool for the complete eradication of the deadly disease. In this paper an automated process has been described which utilizes a different approach compared to the existing works done in this field and reported in the open literature. How a peripheral blood image will look like after Giemsa staining is demonstrated in Figure 1. The parasites, platelets and WBCs are deeply stained where are RBCs are less colorized. Hence in a blood film diagnosis scenario one should consider two facts; firstly the image will

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contain highly stained parasites, WBC and artefacts, very slightly stained RBCs and non-stained plasma. The plasma should be considered as the background of the image and all the other cell/components as the foreground objects. Secondly the parasites reside in the RBCs, which mean a deeply stained component on a lighter background

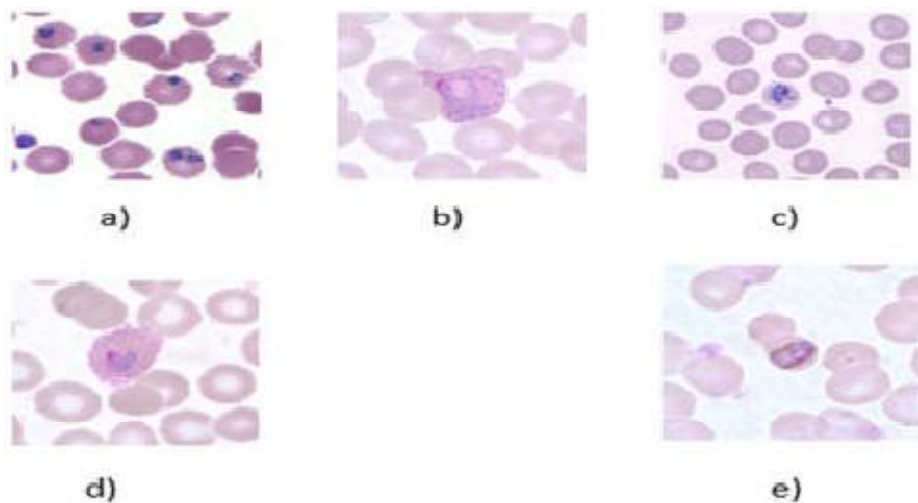


Fig. 1. Species of Malaria parasite, (a) Plasmodium Falciparum (b) P. Vivax (c) P. knowlesi (d) P. ovale (e) P. malariae

### II. LITERATURE SURVEY

S.Kareem, R.C.S Morling and I.Kale[1] has described 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 parasite detection system by scanning a photograph of thin blood film in order to evaluate the parasitemia of the blood. Not only will this method eliminates the segmentation procedures that are normally used to segment the cells in the microscopic image, but also avoids any image pre-processing to deal with non uniform illumination prior to cell 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. A robust and novel method for estimating the RBC count in a thin blood film has been proposed. Different experimental analysis using different images with different contrast and resolution showed that the method is insensitive to the variation to illumination issues and contrast of the cell images. Hence it will reduce the time and complexity required for setting up different acquisition and enhancement facilities for the pre-processing of the images. Not only does it improve the count but it also provides the location of the cells. In addition to that, the method does not require any binarisation as the method works directly on the grayscale image. Furthermore, it achieves 93% sensitivity and 100% specificity in terms of classification.

S.Kareem, R.C.S Morling and I.Kale [2] has illustrated the automated diagnosis of malaria parasite (Plasmodium species) in microscopic images of Giemsa stained thin blood films. The procedure adapts a morphological approach for blood cell identification and uses the image features such as intensity, histogram, relative size and geometry for further analysis. Two methods of object classification have been described for parasite detection; one based on relative size and morphology and the other based on intensity variation. This method is tested on 543 malaria patients and achieves sensitivity and specificity of 90% in the detection of protozoa parasites.

S.Kareem, I .Kale, R.C.S Morling ,”A Novel Fully Automated Malaria Diagnostic Tool Using Thin Blood Films” Pan American Health Care Exchanges (PAHCE2013), Medellin, Columbia, May 2013 [3] This paper illustrates the automated diagnosis of malaria parasite (Plasmodium species) in microscopic images of Giemsa stained thin blood

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films. The procedure adapts a morphological approach for blood cell identification and uses the image features such as intensity, histogram, relative size and geometry for further analysis. Two methods of object classification have been described for parasite detection; one based on relative size and morphology and the other based on intensity variation. Furthermore, an analytical

S.Kareem, I.Kale, R.C.S Morling[4] has discussed that the gametocytes of the malaria parasite *Plasmodium falciparum* are highly resistant to antimalarial drugs. Its presence in the blood can be detected even after a successful malaria treatment. This paper explains a modified Annular Ring Ratio method which successfully locates and differentiates gametocytes of *P.falciparum* species in thin blood film images. The method can be used as an efficient tool for gametocyte detection for post-treatment malaria diagnosis. This method achieves sensitivity of 97.25% and specificity of 96.85%.

BorayTek, Andrew G. Dempster, IzzetKale."Computer Vision for microscopy diagnosis of malaria". Malaria Journal 2009 [5] reviews computer vision and image analysis studies aiming at automated diagnosis or screening of malaria 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. This paper provides a good basis for researchers who are starting to investigate the automated blood film analysis for diagnosis or screening of malaria or similar bloodborne infectious diseases. In this paper, a review and critique of computer vision and image analysis studies which address the automated diagnosis of malaria on thin blood film smears and its necessary auxiliary functions is provided. The results are compared with hand-drawn ground truth which achieves sensitivity of 75.43% and specificity of 99.99%.

WHO: Global report on antimalarial efficacy and drug resistance: 2000-2010 [6]: This report provides a comprehensive, global overview of antimalarial drug efficacy and the resistance of malaria parasites to the antimalarial medicines used between 2000 and June 2010. Policy-makers in national ministries of health will benefit from this document, as it provides both a global and a regional picture of the efficacy of the antimalarial medicines currently used in national treatment programmes. In addition, the report will be a reference for scientists, enhancing their understanding of the complexity of antimalarial drug resistance.

Anna Rosanas-Urgell, Dania Mueller, Inoni Betuela, Céline Barnadas, Jonah Iga, Peter A Zimmerman, Hernando A del Portillo, Peter Siba, Ivo Mueller and Ingrid Felger [7] have studied an "Accurate diagnosis of *Plasmodium* infections is essential for malaria morbidity and mortality reduction in tropical areas. Despite great advantages of light microscopy (LM) for malaria diagnosis, its limited sensitivity is a critical shortfall for epidemiological studies. Robust molecular diagnostics tools are thus needed. The present study describes the development of a duplex quantitative real time PCR (qPCR) assay, which specifically detects and quantifies the four human *Plasmodium* species. Performance of this method was compared to PCR-ligase detection reaction-fluorescent microsphere assay (PCR\_LDR\_FMA), nested PCR (nPCR) and LM, using field samples.

C.DiRuberto, Andrew G. Dempster, S.Khan, and B.Jarra,"Analysis of infected blood cell images using morphological operators,"Image and vision computing, vol 20,no.2,pp.133-146,February 2002 [8] :This paper reviews computer vision and image analysis studies aiming at automated diagnosis or screening of malaria 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.

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## III. BLOCK DIAGRAM

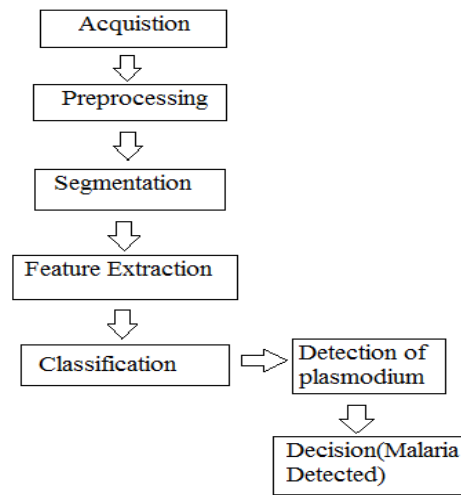


Fig 2 Block Diagram of the proposed system

## IV. RESULT

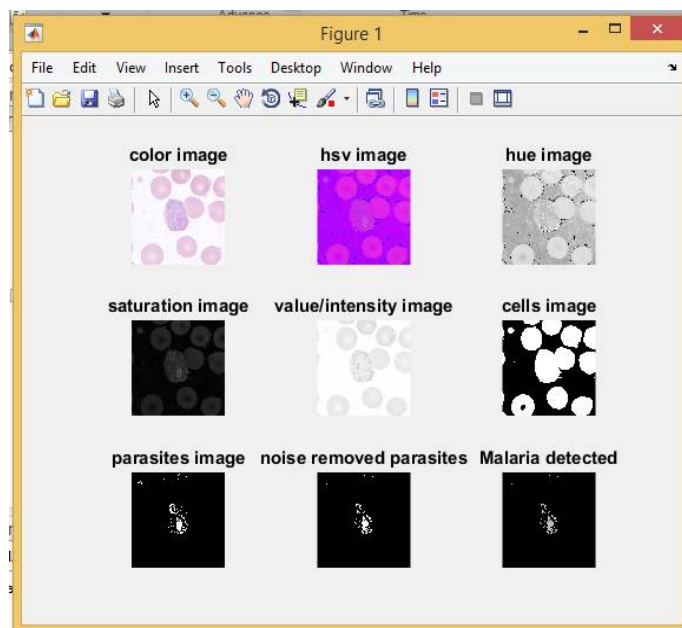


Fig 3 a) Color Image b)hsv Image c)hue Image d)saturation Image e) value Image f)parasite Image g)noise removed parasites h)Malaria detected.

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## V. CONCLUSION

A system for detecting Plasmodium parasites was implemented. The images used in this work were collected from different sources, then the images were processed and certain features were extracted. These features were then used to detect the presents of the malaria parasite. In this work, an accurate, rapid and affordable model of malaria diagnosis using stained thin blood smear images was developed.

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