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AUTOMATIC DETECTION OF MALARIA PARASITES FOR ESTIMATING PARASITEMIA: Review Paper

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Abstract

This paper describes a fast and reliable mobile phone Android application platform for blood image analysis and malaria diagnosis from Giemsa stained thin blood film images. The application is based on novel Annular Ring Ratio Method which is already implemented, tested and validated in MATLAB. The method detects the blood components such as the Red Blood Cells (RBCs), White Blood Cells (WBCs), and identifies the parasites in the infected RBCs. The application also recognizes the different life stages of the parasites and calculates the parasitemia which is a measure of the extent of infection. The main objective of the research is to successfully implement the application on to the mobile platform without the loss of information integrity, with minimal memory footprint on the mobile phone. In this paper, an attempt has been made to implement the malarial diagnosis algorithm, that has already been implemented, tested and evaluated on a MATLAB platform into an Android mobile phone. The main objective of the research is to successfully implement the application on to the mobile platform without the loss of information integrity, with minimal memory footprint on the mobile phone.

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Keyword- *OTSU Thrsholding, Feature Extraction, SVM Classifier, Malaria, Android, SD card, Java, RBC, WBC, Annular Ring Ratio method, RGB to gray scale conversion, Trophozoite, Schizonts, Gametocytes*

I.INTRODUCTION

Malaria is a serious disease caused by a blood parasite named Plasmodium spp. It affects at least 200 to 300 million people every year and causes an estimated 3 million deaths per annum. Diagnosis and medication of it is necessary. In blood sample visual detection and recognition of Plasmodium spp is possible and efficient via a chemical process called (Giemsa) staining. The staining process slightly colorizes the RBCs but highlights Plasmodium spp parasites, white blood cells (WBC), and artifacts. Giemsa stains nuclei, chromatin in blue tone and RBCs in pink color. It has been shown in several field studies that manual microscopy is not a reliable screening method when performed by non-experts. Malaria parasites host in RBCs when it enter in blood stream. In Malaria parasitemia count it is important step to segment RBCs from blood image and classify it as parasite infected or normal. In thin blood images morphology of cells can be observed clearly. The present paper describes the techniques used in segmenting normal and infected RBCs for purpose of Malaria parasitemia (number of infected blood cells over total red blood cell) count.

This paper is organized as follows: it summarizes literature related to segmentation of cells and count Malaria parasitemia. Then illustrates the system architecture which includes pre-processing, cell segmentation, RBCs segmentation, feature extraction and classification. Malaria is a common but serious protozoan disease caused by peripheral blood, spleen or liver parasites of the genus Plasmodium.

There are four species of Plasmodium parasites that cause malaria in humans. These are Plasmodium falciparum, Plasmodium ovale, Plasmodium vivax and Plasmodium malariae. These species of Plasmodium attack red blood cells and undergo various life stages namely, early trophozoites, mature trophozoites, gametocytes and schizoites.

It is estimated that approximately 781,000 people of the 225 million people infected worldwide by the disease succumb to this menace annually. Majority of these deaths are children from sub-Saharan Africa In

Kenya malaria accounts for 30 – 50% of all outpatient attendance and 20% of all admissions in health facilitates. It is also estimated that 20% of all deaths of children under five years is due to malaria The disease causes a heavy economic burden to those affected in terms of the costs incurred to treat the disease and absenteeism from work and school.

World Health Organization (WHO) has estimated that malaria causes over 200 million cases of fever annually. The diagnosis of the disease requires powerful and expensive tools unavailable for the poorest countries of the world, where often the disease is endemic. Microscopic malaria diagnosis is, by far, considered to be the most effective diagnostic method, but it is highly time-consuming and labour intensive. The accuracy of the system solely depends on the expertise of the microscopist . Other techniques widely involved in Malaria diagnosis are Rapid Diagnostic Tests (RDTs) and Polymerase Chain Reaction (PCR) tests . However, the accuracy of these tests depends on the extent of infection with sensitivity directly proportional to the level of infection. Various automated malaria related diagnostic studies are described in . Recognizing the potential of mobile technology and internet to revolutionize the access to information throughout the developing countries like India and Africa as well as developed nations, the work reported in this paper exposes a reliable automated Android based diagnostic platform, without 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. In this paper, an attempt has been made to implement the malarial diagnosis algorithm, that has already been implemented, tested and evaluated on a MATLAB platform[3]-[5], into an Android mobile phone. The main objective of the research is to successfully implement the application on to the mobile platform without the loss of information integrity, with minimal memory footprint on the mobile phone.

II. LITERATURE SURVEY

A number of studies on the possibility of automating conventional microscopy have been done in the past. In this section a number of these studies are reviewed.

Zoueu*et al.* (2008) [1], proposed a method of diagnosing malaria without labelling the parasites using a light microscope with LEDs emitting in the range of UV to IR replacing the classic white light. The microscope was fitted with a digital camera to capture images formed at the eye piece. It was reported that parasite images having the best contrast were recorded for blue light. This study, however, failed to address the effects of chromatic aberration which are common in multispectral imaging using classical optics. Chromatic aberration causes images of specimen in a light microscope to be formed in different focal points for different wavelengths of light used to illuminate the specimen. This would therefore pose a challenge in automating the detection and classification of *Plasmodium* parasites because adjustment of focal point would be required for every wavelength used for illumination. The technique was also dependent of a human operator for switching between LEDs and making the diagnosis

Brydegaard*et. al*.(2011) [2], proposed an improved version of multispectral microscope based on light emitting diodes (LEDs). The LEDS emitted lights in 13 spectral bands ranging from ultra-violet (UV) to near infra-red (IR). The dispersive optical components of the instrument were made of quartz to reduce achromatic aberration and lens fluorescence in illumination profiles towards the ultraviolent region. The device was also fitted with an imager for capturing images in the 13 spectral range of the LEDs. The instrument was interfaced to a computer and switching of LEDs and image capturing was done using LAB-VIEW software. It was reported that the instrument could detect *Plasmodium* parasites in non-stained thin blood smear images. However, species and stages differentiation of *Plasmodium* parasites was not addressed.

Minh-Tam Le et. al. [3] ,proposed a comparison-based analysis, which differentiates solid components in blood smears. The semiautomatic method uses statistical measures and crossr eferencing validations yields a reliable detection scheme. The nucleated components are identified using adaptable spectral information. Cells and parasites are isolated from the background, by comparing the input image with an image of an empty field of view. The range of erythrocyte sizes is determined by input of isolated RBC.

Jesus Angulo et. al. [4], presents a technique to automatically detect the working area of peripheral blood smears stained with Giemsa. The approach consists of two stages. First, an image analysis

procedure using mathematical morphology is applied for extracting the erythrocytes, the centers of erythrocytes and the erythrocytes with center. Second, the number of connected components from the three kinds of particles is counted.

D. Ruberto et. al. [5] follow morphological method for detection of parasites in Giemsa stained blood slides. Different objects in blood are identified using their dimensions and color. The parasites are detected by means of an automatic thresholding based on morphological approach, using Granulometrices to evaluate size of RBCs and nuclei of parasite. A segmentation method using morphological operators combined with the watershed algorithm.

Silvia et. al. [6], proposed a technique for estimating parasitemia. Template matching is used for detection of RBCs. Parasites are detected using variance-based technique from grayscale images and second approach is based on color co-occurrence matrix. Support Vector Machine (SVM) as the classifier which exploits the texture, geometry and statistical features of the image. Stanislaw Osowski et. al. [7], presents the application of a genetic algorithm (GA) and a support vector machine (SVM) to the recognition of blood cells on the image of the bone.

III. OBJECTIVES:

The objective of the project is to develop a fully automated image classification system to positively identify malaria parasites present in thin blood smears, and differentiate the species. The algorithm generated will be helpful in the area where the expert in microscopic analysis may not be available. The effort of the algorithm is to detect presence of parasite at any stage. One of the parasites grows in body for 7 to 8 days without any Symptoms. So if this algorithm is incorporated in routine tests, the presence of malarial parasite can be detected Automatic parasite detection has based on color histograms. In a diagnosis scenario In this study we have proposed a solution for the parasite detection problem with two consecutive classifications.
The preliminary aim of blood image analysis for malaria parasite detection is to recognize different objects present in the image prior to differentiating them as parasites and nonparasites.[4] The foreground region of an infected blood image consists of RBCs, WBCs, parasites, platelets and any artefacts or noises induced by various other imaging factors. A sequence of image processing techniques is used to differentiate them and remove some as and when necessary.

The aim is to develop a system that would offer speedy and accurate malaria diagnosis in human blood media based on the colour and morphological features of Plasmodium parasites and infected erythrocytes. The specific objectives were as follows:

1. To develop suitable algorithms for:

(a) Detecting Plasmodium parasites

(b) Classifying the parasites into their respective species

(c) Classifying the parasites into their life stages

(d) Estimating parasitemia

2. To assess the accuracy of the developed algorithms in:

(a) Plasmodium parasite stages differentiation

(b) Plasmodium parasite species differentiation

(c) Parasitemia estimation

The objective is to implement the algorithms realised in Matlab on an Android application platform using java to yield real-time performance.

1. A mobile malaria diagnostic application has been developed which will enable real-time diagnosis on Android mobile phones (Version 2.2 and above).

2. The application was written in Java and successfully reproduces the results obtained from our Matlab development environment one to one in real-time.
3. The application has the facility to acquire slide images from the inbuilt phone camera or a file.

4. We are now ready for the optical interface that will turn the mobile phone camera into a microscope being designed by project partners from Anna University to for field trials.

IV. PROPOSED TECHNIQUE FOR MALARIA DIAGNOSIS ON ANDROID MOBILE PHONE

1 Annular Ring Ratio (ARR) Transform

The main approach is the novel Annular Ring Ratio (ARR) transform which detects the centroid of each RBC in the image [3]. In this technique the colour image is converted to gray scale to speed up the processing. It then undergoes morphological filtering operation which involves dilation followed by erosion using different structuring element (SE), a concentric ring SE for dilation (as in Fig 1-a) and a disk shaped SE for erosion (as in Fig 1-b). The radius of the structuring element depends on the radius of the RBC, so that any component smaller than the RBC will be removed upon completion of these operations. A ring structuring element is used for dilation in order to avoid the lighter centre patch of the RBC attenuating the intensity of the closed grey scale image as would occur if a conventional disk is used. The dilation is followed by erosion using a disk shaped structuring element. Erosion expands the size of darker object in a lighter background and is performed in order to restore the dilated RBCs.

2. Mobile Phone Deployement Of The Algorithm

The algorithm described above has already been implemented in the Matlab environment and has been successfully tested and validated. The implementation of the application on Android Operating System (AOS) needs specialist software for Android and the Java development tool. Eclipse IDE has been downloaded with Java JDK and JRE toimplement this algorithm in Java. For Android based mobile phone implementation, Android SDK has been added to Eclipse. Moreover, an Android mobile device with a minimum requirement of Android version 2.2 is essential.

V.CONCLUSION

- An efficient and reliable mobile phone application to diagnose Malaria has been implemented and reported in this paper.
- The application takes less than 60 seconds to give a diagnosis, which will otherwise take hours in the clinical laboratories.
- This project has been tested and verified on several version and types of Android mobile phones and tablets.
- The application has tremendous potential in the quantitative analysis of the blood images and is not limited to malaria diagnosis.
- The research will focus on the benefits it can provide for the successful diagnosis of malaria, and the supportive treatment and further studies in even the most remote and poverty-stricken environments. This application will be a step for mobile diagnosis of Malaria and could be extended to other blood related infections.

VI.REFRENCES

1) Corentin Dallet *, Saumya Kareem*, Izzet Kale*“Real Time Blood Image Processing Application for Malaria Diagnosis Using Mobile Phones” 2014 IEEE

2) Vishnu V. Makkapati and Raghuveer M. Rao “SEGMENTATION OF MALARIA PARASITES IN PERIPHERAL BLOOD SMEAR IMAGES”, „IEEE Transaction 2009 IEEE

3) S. S. Savkare and S. P. Narote “Automatic Detection of Malaria Parasites for Estimating Parasitemia”India International Journal of Computer Science and Security (IJCSS), Volume (5) : Issue (3) : 2011

4) Pallavi T. Suradkar “Detection of Malarial Parasite in Blood Using Image Processing” ‘International Journal of Engineering and Innovative Technology (IJEIT) Volume 2, Issue 10, April 2013

5) Matthias Elter, Erik Haßlmeyer and Thorsten Zerfaß “Detection of malaria parasites in thick blood films”,Annual International Conference of the IEEE EMBS Boston, Massachusetts USA, August 30 - September 3, 2011

6) M. Tam Le, T. Bretschneider,“A novel semi-automatic image processing approach to determine Plasmodium falciparum parasitemia in Giemsa-stained thin blood smears”, Research article, BMC Cell Biology, 28 March 2008.

7) J. Angulo, G. Flandrin, "Automated detection of working area of peripheral blood smears using mathematical morphology", U. S. National Library of Medicine, Analytical Cellular Pathology 25(1), pp 39-47, 2003.

8) C.D. Ruberto, A.G. Dempster, S. Khan, and B. Jarra, "Automatic Thresholding of Infected Blood Images Using Granulometry and Regional Extrema", in Proceedings of International Conference on Pattern Recognition, pp 3445-3448, 2000.

9) S. Halim et al., "Estimating Malaria Parasitaemia from Blood Smear Images", in Proceedings of IEEE international conference on control, automation, robotics and vision, pp 1-6, 2006.

10) S. Osowski et al., "Application of Support Vector Machine and Genetic Algorithm for Improved Blood Cell Recognition", in proceedings of IEEE transaction on Instrumentation and Measurement, Vol. 58, No. 7, pp 2159-2168, July 2009.

11) WHO: Global report on antimalarial efficacy and drug resistance: 2000-2010

12) 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 ," Comparison of diagnostic methods for the detection and quantification of the four sympatric Plasmodium species in field samples from Papua New Guinea" Malaria Journal 2010,Volume 9, www.malariajournal.com.

13) S.Kareem,R.C.S Morling, I Kale "A Novel Method to Count the Red Blood Cells in Thin Blood Films"IEEE International Symposium Circuits and Systems (ISCAS), 2011, Pages 1021-1024

14) S.Kareem, I Kale, R.C.S Morling "Automated Malaria Parasite Detection in Thin Blood:- A Hybrid Illumination and Color Constancy Insensitive, Morphological Approach"

15) 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

16) S.Kareem, I Kale, R.C.S Morling "Automated P.falciparum Detection system for Post-treatment Malaria Diagnosis using Modified Annular Ring Rat io Method" IEEE 14th International Conference on Computer Modelling and Simulation, March 2012