"A SURVEY ON DETECTION AND CLASSIFICATION OF PLASMODIUM PARASITES USING MACHINE LEARNING TECHNIQUE"

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Abstract : Malaria is responsible for nearly 438,000 deaths worldwide in a year. A total of 214 million cases of malaria are encountered annually. The conventional method for testing malaria is through microscopy. A blood sample of the patient is spread over a glass slide, stained with Giemsa stain and examined under a microscope. It takes a few hours and a highly trained professional to visually examine the slide and give the results. It is even more difficult to detect the different types of malaria parasite and their stages by the conventional methods. In this work an image processing system was developed to identify malaria parasites in thin blood smears and to classify them into one of the four species of malaria. Many techniques were implemented in the preprocessing stage to enhance the images. In the first part of the system morphological processing is applied to extract the Red Blood Cells (RBC) from blood images. The developed algorithm picks the suspicious regions and detects the parasites in the images including the overlapped cells. Accordingly, the RBCs are classified into infected and non-infected cells and the number of RBCs in each image is calculated. The aim of this paper is to review and analyze the recent work of different researchers in the area of malaria parasite. This paper provides a good basis for researchers who are starting to investigate the computer aided malaria diagnosis methods.

Keywords* - Malaria parasite, Plasmodium, Feature Extraction, Classification, *Malaria diagnosis

I. INTRODUCTION

Malaria is a fatal parasitic disease found all around the world particularly in tropical and subtropical countries. The parasite undergoes a complex life cycle inside the human body, using the red blood cells (RBCs) as hosts. Malaria can lead to death rapidly if it is untreated. Malaria is a serious public health problem in many parts of the world, causing millions of deaths every year in more than 90 countries. According to World Health Organization (WHO) report about 3.2 billion humans (approximately half of the world's population) are at risk of malaria, causing about one million of people death every year. According to the latest WHO estimates, released in September 2015, there were 214 million cases of malaria in 2014 and 438,000 deaths. Malaria is prevalent in the tropical and subtropical regions near the equator like Asia, Sub-Saharan Africa, and Latin America. The disease is caused by Genus Plasmodium parasites and transmitted by the female anopheles mosquito. Example of Malaria Parasites is shown in Fig (A).

Fig (A) Example of Malaria Parasites

Since 2010, WHO has suggested malaria diagnostic testing by either light microscopy or rapid diagnostic test (RDT). RDT is used where microscopy or well-trained microscopist is not available; this method gives instant results but main disadvantage of RDT is that parasite density cannot be estimated. Microscopy method is "Gold Standard" for detecting malaria parasites and estimating parasite density. The infections of malaria are diagnosed manually by pathologists who observe the microscopic images of strained blood files on glass slides and count the infected blood cells. If sample size of patient is large, there is always a chance to detect inaccurately. There is human error possibility. The accuracy of the microscopy diagnosis of malaria depends on the pathologist's expertise in the subject. This procedure is tedious and erroneous due to subjectivity, which can lead to incorrect and inconsistent diagnoses and could result in an incorrect treatment and even loss of life of the patient. Consequently, conventional microscopy diagnosis cannot be recommended as a safe testing strategy. Due to this drawback, the objective of this study is to develop a computerized malaria detection framework that replicates the conventional gold standard diagnosis of malaria to identify malaria parasites in blood smear images.

II. LITERATURE REVIEW

With the aim to present a detection and classification of malaria parasites various effective systems were developed with the available resources and suitable technology. In the literature, many authors have attempted the parasites diagnosis of the microscopic images. Some literature works are as follows:

F. Sadeghian, Z. Seman and A. R. Ramli [3] proposed a system which processes a blood image in order to detect and classify parasitemia in blood. A statistical based approach is used in order to detect infected RBCs. Color, shape, and size of the information are used to separate the parasites. The images obtained finally are analyzed statistically in order to form a mathematical base. The shape and size of the nuclei is considered as well. The Automated system based on image analysis "Malaria count" for parasitemia determination is presented in this paper is based on edge detection that represents cells and boundaries of parasites. The system is based on the techniques including pre-processing, edge detection, linking of edge, clump splitting and detection of parasites. The methods start from pre-processing, that involves contrast enhancement followed by detection of edges. The system requirements are well separated and well stained cells for efficient results.

C. Di Ruberto, A. Dempster, S. Khan and B. Jarra, [4] proposed a framework for the WBCs segmentation by digital image processing . The process is divided into two parts. First the morphological analysis based nucleus segmentation and then pixel intensity based cytoplasm segmentation. A segmentation framework is presented which is an integration of several segmentation approaches. The dataset consists of 20 thin blood smear images. The accuracy of the nucleus and the cytoplasmic segmentation were 92 & 78 respectively. The presented framework has the ability to extract the nucleus and cytoplasmic regions in a WBC sample image.

K.Edward [7] proposed a morphological approach to cell segmentation and that is accurate than watershed based algorithm. Non-flat disk shaped structuring elements proved to improve the normal watershed based algorithm whereas flat disk shaped structuring element separated the overlapping cells. The applied method is better than existing watershed segmentation.

S.Kamolrat [8] proposed a work to detect the parasites of malaria by the support vector machine and artificial neural network. The plan assesses a segmentation based on color to separate the pixels into 3 classes, parasite, RBCs and the background based on standard classification algorithms. KNN, Naïve Byes, SVM and ANN are four different techniques which are evaluated on different color spaces RGB, HSV, YCbCr the complex mix of colors that are presented in parasite makes the discrimination of pixels difficult. The digital image of oil immersion view from microscopic slides captured through a capture card is done by Premaratnea. The images were segmented and very converted into gray scale in order to minimize their dimensionality and then are fed into a fed forward back propagation neural network in order to train them as seen in work by K. Edwards.

Deepa. A. Kurer et al. [9], proposed a new approach for low-level image processing -SUSAN (Smallest Unvalued segment assimilating nucleus) Principle, which performs Edge and Corner detection. Image features based on color, texture and the geometry of the cells and parasites are generated, as well as features that make use of a priori knowledge of the classification problem and mimic features used by human technicians. A two-stage tree classifier distinguishes between true and false positives, and then diagnoses the four types of the infection. The algorithm detects the species of parasite with a sensitivity of 99% and a positive predictive value of 90-92.

Daniel Maitethia Memeu et al. [10] proposed a method for detection of plasmodium parasites from images of thin blood smears. The method is based on Artificial Neural Net-work (ANN) for testing the presence of plasmodium parasites in thin blood smear images. Pre-processing, features extraction are implemented and eventually diagnosis was made based on the features extracted from the images. Classification accuracy of 95.0% in detection of infected erythrocyte was achieved with respect to results obtained by expert microscopes.

G.Diaz, A. Gonzalez, E.Romero [12] presented the paper which processes a blood image in order to detect and classify parasitemia in blood. A statistical based approach is used in order to detect infected RBCs. Color, shape, and information of the size are used to separate the parasites. The images obtained finally are analysed statistically in order to form a mathematical base. The shape and size of the nuclei is considered as well.

A framework for the WBCs segmentation by digital image processing is presented in Sadeghian et al [13]. The process is divided into two parts. First the morphological analysis based nucleus segmentation and then pixel intensity based cytoplasm segmentation. A segmentation framework is presented which is an integration of several segmentation approaches. The dataset consists of 20 thin blood smear images. The accuracy of the nucleus and the cytoplasmic segmentation were 92 & 78 respectively. The presented framework has the ability to extract the nucleus and cytoplasmic regions in a WBC sample image.

A morphological approach to cell segmentation is introduced by Ruberto et althat is accurate than watershed based algorithm. Non-flat disk shaped structuring elements proved to improve the normal watershed based algorithm whereas flat disk shaped structuring element separated the overlapping cells. The applied method is better than existing watershed segmentation.

The work presented by Diaz et al [14] contributes to detect the parasites of malaria by the support vector machine and artificial neural network. The plan assesses a segmentation based on color to separate the pixels into 3 classes, parasite, RBCs and the background based on standard classification algorithms. KNN, Naïve Byes, SVM and ANN are four different techniques which are evaluated on different color spaces RGB, HSV, YCbCr the complex mix of colors that are presented in parasite makes the discrimination of pixels difficult.

The digital image of oil immersion view from microscopic slides captured through a capture card is done by Premaratnea [15]. The images were segmented and very converted into gray scale in order to minimize their dimensionality and then are fed into a fed forward back propagation neural network in order to train them.

Sio,W.S.S, et al [16] presented the automated system based on image analysis "Malaria count" for parasitemia determination based on edge detection that represents cells and boundaries of parasites. The system is based on the techniques including pre-processing, edge detection, linking of edge, clump splitting and detection of parasites. The methods start from pre-processing, that involves contrast enhancement followed by detection of edges. The system requirements are well separated and well stained cells for efficient results.

III. CONCLUSION

This paper provides a basis to researchers who want to start research in the area diagnosis of malaria based on microscopic blood images. The focus is to review, analyze and categorize malaria recognition algorithms, techniques and methodologies and uncover existing limitations. The problems faced by pathologist are also discuss. The review is presented for four significant stages of automated malaria parasite diagnosis namely image pre-processing, parasite segmentation, feature extraction and classification. . KNN, Naïve Byes, SVM and ANN are four different techniques can be used for classification.

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REFERENCES

[1] G.Diaz, A. Gonzalez, E.Romero, "A Semi-Automatic method for Quantification and Classification of Ethrocytes Infected with Malaria Parasites in Microscopic Images, "Journal of Biomedical Informatics, Vol. 42, pp.296-307, 2009.

[2] Sio,W.S.S, et al, "MalariaCount:An image analysis-based program for the accurate determination of parasitemia," Journal of Microbiological Methods, ISSN-0167-7012, vol. 68, issue 1, pp. 11-18, 2007.

[3] F. Sadeghian, Z. Seman and A. R. Ramli, "A Framework for White Blood Cell Segmentation in Microscopic Blood Images Using Digital Image Processing," Biological Procedures Online, Vol. 11, no. 1, pp. 196-206, Dec. 2009.

[4] C. Di Ruberto, A. Dempster, S. Khan and B. Jarra, "Segmentation of blood images using morphological operators," Proceedings of 15th International Conference on Pattern Recognition Barcelona, Spain, Vol. 3, pp. 3401, 2000.

[5] Diaz G., Gonzalez F., Romero E, "Infected Cell Identification in thin Blood Images Based on Color Pixel Classification: Comparison and Analysis," CIARP-2007 Springer Berlin, pp. 812-821, 2007.

[6] S. P. Premaratnea, N. D. Karunaweerab and S. Fernandoc, "A Neural Network Architecture for Automated Recognition of Intracellular Malaria Parasites in Stained Blood Films", 2003.

[7] K.Edward, "Malaria Diagnosis in the Community:Challenges and Potential Role of Rapid Diagnostic Tests (RDTs) in the African Region," African journal of Health Sciences, Vol.14, pp.114-117,2007.

[8] S.Kamolrat "Standard Operating Procedure: Malaria Slide Management," Mahidol Oxford University Research Program. Version 10.2013.

[9] Deepa.A.Kurer, Vineeta.P.Gejji, "Detection of Malarial Parasites in Blood Images," International Journal of Engineering Science and Innovative Technology (IJESIT),Volume 3, Issue 3, May 2014.

[10] Daniel Maitethia Memeu et al, "Detection of plasmodium parasites from images of thin blood smears," International Journal of Engineering Science and Innovative Technology (IJESIT), *University of Nairobi, Nairobi, Kenya* , Open Journal of Clinical Diagnostics, 3, 183-194, 2013.*d*

[11] V.Joost, G.Theo, G.Jan-Mark "Edge and Corner detection by Photometric Quasi-Invarints," IEEE Transactions on Pattern Analysis and machine Intelligence, Vol.27, No.4,pp.625-630, 2005.

[12] G.Diaz, A. Gonzalez, E.Romero, "A Semi-Automatic method for Quantification and Classification of Ethrocytes Infected with Malaria Parasites in Microscopic Images,"Journal of Biomedical Informatics, Vol. 42, pp.296-307, 2009.

[13] F. Sadeghian, Z. Seman and A. R. Ramli, "A Framework for White Blood Cell Segmentation in Microscopic Blood Images Using Digital Image Processing," Biological Procedures Online, Vol. 11, no. 1, pp. 196-206, Dec. 2009.

[14] Diaz G., Gonzalez F., Romero E, "Infected Cell Identification in thin Blood Images Based on Color Pixel Classification: Comparison and Analysis," CIARP-2007 Springer Berlin, pp. 812-821, 2007.

[15] S. P. Premaratnea, N. D. Karunaweerab and S. Fernandoc, "A Neural Network Architecture for Automated Recognition of Intracellular Malaria Parasites in Stained Blood Films", 2003.

[16] Sio,W.S.S, et al, "MalariaCount:An image analysis-based program for the accurate determination of parasitemia," Journal of Microbiological Methods, ISSN-0167-7012, vol. 68, issue 1, pp. 11-18, 2007.