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MALARIAL PARASITE DETECTION USING GAUSSIAN MIXTURE MODEL(GMM)

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ABSTRACT

Malaria is a deadly disease and the recent survey by the World Health Organization (WHO) has estimated that malaria causes over 200 million cases of fever annually. The malaria is mostly diagnosed by examining properly stained peripheral blood smear because the protozoal infection parasite invades red blood corpuscles (RBC) of the cardiovascular system. For this reason, correct analysis of red blood cell is that the most confirmative diagnosis of protozoal infection. Here in this paper, completely different approach for proper identification of presence of protozoal infection of parasite is mentioned. 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.

KEYWORDS: RBC, WBC, GMM Filtering, ARR.

INTRODUCTION

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 [3. However, the accuracy of these tests depends on the extent of infection with sensitivity directly proportional to the level of infection.

PROPOSED METHOD

Background

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. The foreground region of an infected blood image consists of RBCs, WBCs, parasites, platelets and any artifacts 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.

System Implementation

The design is essentially an image classification problem, and thus takes the form of a standard pattern recognition and classification system. It consists of five stages:

1. Image Acquisition (Done using high resolution Digital Camera)
2. GMM Filtering
3. Edge Detection
4. Binary Image
5. RBC Counting
6. Thresholding
7. Parasite Extraction

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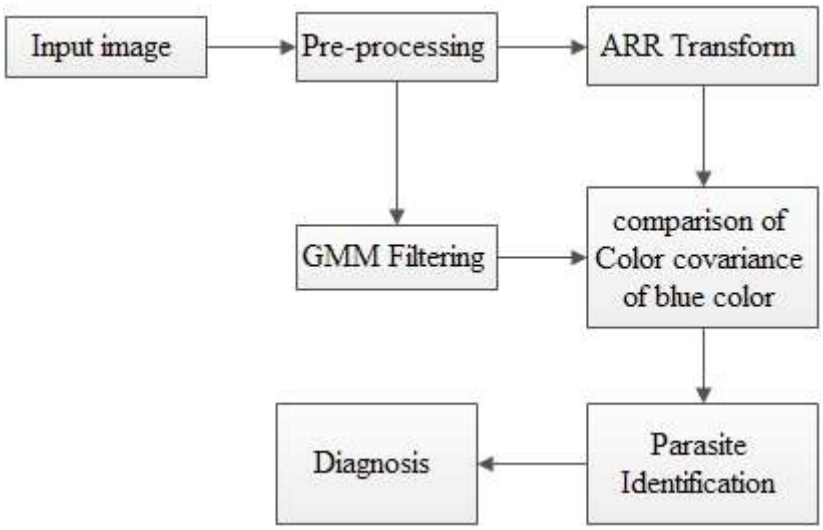
System architecture used for Malaria parasite detection involves following steps: Thresholding, gray scale image conversion, binary image, edge detection algorithm, thinning of binary image, labeling algorithm. Block diagram of system architecture is shown in following figure

Figure:



System Architecture

GMM Filtering

To detect the infected cells within an RBC, the GMM filtering of the original picture is used. The method performs image binarisation using thresholding of the intensity of blue colour and search for the localized maxima. The search is defined in terms of RBC radius surrounding the already located centroid. Once the infected cells are detected, a modified ARR method is performed to detect the nuclei in each RBCs.

The Gaussian Mixture Model (GMM) is a generative method to clustering, where each cluster corresponds to a Gaussian distribution, and each example is drawn from its cluster specific distribution. Given a set of examples, one can use the Expectation-Maximization algorithm to learn the parameters of the model that maximize the likelihood of the data. Once estimated, these parameters naturally lead to a clustering of the data: assign each example to the Gaussian distribution it is most likely to originate from. Parameter estimate in GMMs is a maximum possibility estimation problem, and therefore, clustering benefits from the statistical properties of these estimators.

Annular Ring Ratio method

The purpose of ARR transform is to remove undesirable objects and noise from the image to detect centroid of each RBC cells. The steps required to carry out ARR transform were implemented on low resolution pictures are as follows:

a) Load coloured (RGB) or gray scale image, the coloured image is converted to gray scale image. The contrast of the gray scale image is improved using local histogram equalization to enhance the visibility of the parasites and RBC.

b) The next and important step in image segmentation is to extract expressive regions, or in other words, distinguish objects from background. The normal way to described in the literature is to use edge detection algorithms. Edge detection or boundary detection algorithm is used to segment image into meaningful regions, i.e. RBC and artifacts from the background.

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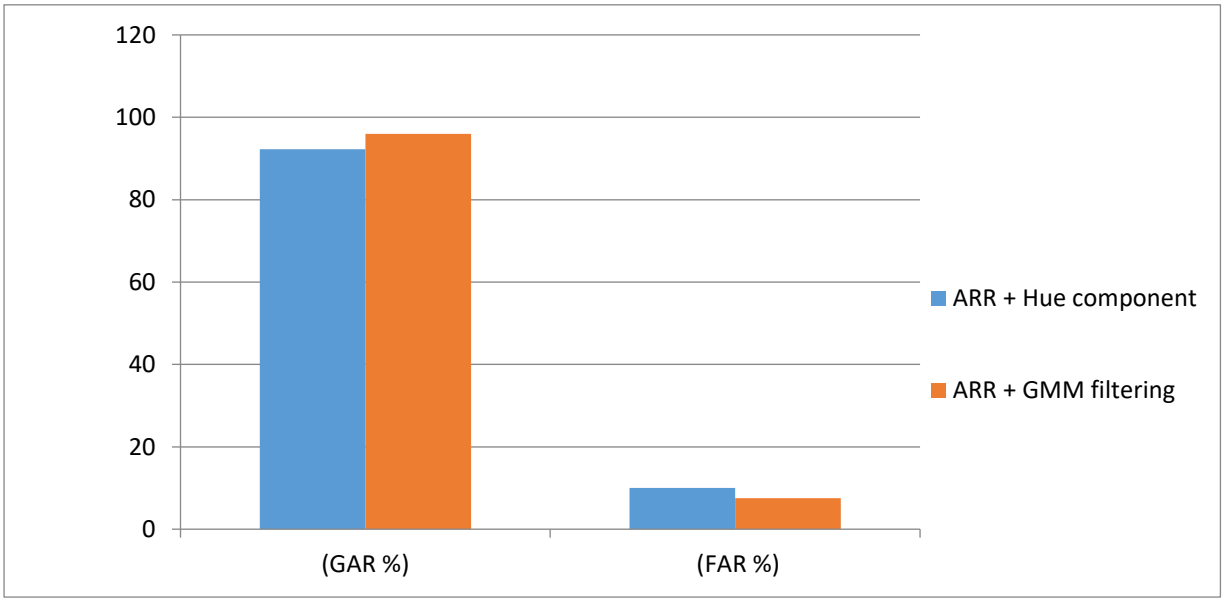
RESULTS AND DISCUSSION

The GMM filtering method reduces Error Rate and increase in rate of GAR. The results of the proposed method has been quantitatively evaluated using GAR(Genuine Acceptance Ratio) and FAR (False Acceptance Ratio). Following Table shows comparison of ARR+ Hue component with ARR+GMM filtering. Figure shows graphical representation of result.

Algorithm	(GAR %)	(FAR %)
ARR + Hue component	92.27	10
ARR + GMM filtering	96	7.5

Table: GAR and FAR for Existing and proposed method



CONCLUSION

GMM filtering helps to increase rate of identification of infected cell and reduce error rate of the system. Comparison of blue Colour covariance improves the accuracy and helps to diagnosis level of malaria. In proposed method GAR increases by 3.73%. False Acceptance Ratio reduces by factor of 2.5%.

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