Malaria parasite detection with histogram color space method in Giemsa-stained blood cell images

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Abstract : Malaria is one of the leading causes of death, especially in high-risk groups die infants, toddlers, and pregnant women. In the world of almost 1 million people die because of it every year. Malaria is transmitted by the bite of a female Anopheles mosquito vectors that have been infected by Plasmodium. Identification of Plasmodium in the blood is done by visual observation blood cells using a microscope. To aid this process, some research are carried out to develop identification plasmodium using methods based computer aided diagnosis (CAD) and digital image processing. The infected cells are extracted typically using image grayscale. In this study, image on the pigment color space and color space are compared so that the intensity will be obtained an optimum color channels in the process of the appearance of the parasite plasmodium features. This study used a sample of Giemsa-stained blood cell images which are infected with the malaria parasite. the results of this study stated after the histogram on the image that the results are graphed evenly and no dominant, and the image looks more clear.

Keyword : malaria, histogram, giemsa-stained, blood cell

I. INTRODUCTION

Indonesia is one of country with a considerable spread of malaria, malaria occurs in Indonesia are caused by Plasmodium falciparum and Plasmodium vivax. Plasmodium vivax is the largest cause death of malaria[5]. Delays handlers that have an impact on the patient's death due to the lack of information to be malaria besides other causes are any errors or delays in the identification by medical or expert. In the analysis done by testing the patient malaria parasite species and stage of the parasite. Results of identification of blood cells or blood are used as a reference in the treatment of Patients.

Blood identification is carried out visually where preparations or blood samples viewed through microscope to determine the phases or types of parasites. However, this technique has the disadvantage which is influenced often by a tool used (especially the quality of the microscope used), and skills / expertise and experience possessed by paramedics or specialist.

Many research had been done in the development of identification techniques using computer assistance. Image processing concept is used in analyzing the results of the blood samples that had been infected with parasites. In analyzing blood samples infected with the parasite by using image processing techniques, there are four stages which are the image acquisition, the process of separating the object image (image segmentation), the process of feature extraction of objects, and the classification process or grouping based on similar features of the object. The stages of the separation of the object has an important role where the stage has the role of separating between the object to be searched with the objects around it. Errors in identifying the object to be searched will have an impact on the results of the analysis of data, so the accuracy of separation of objects is very important.

Extraction of infected cells are typically grayscale image. In some studies approach uses channel grayscale imagery with experienced miraculous error. Errors in determining the parasite cells and red blood cells, in some cases on blood samples infected with malaria parasites, have a negative result of malaria detection. Fault diagnoses are caused by leukocyte cells that have the same hue with the parasite cells.

II. METHOD

A. Malaria

Malaria is an infectious disease caused by the parasite Plasmodium that can be characterized by fever, hepatosplenomegaly and anemia. Plasmodium live and breed

in human red blood cells. This disease is naturally transmitted by the bite of a female Anopheles mosquito. Plasmodium species in humans are (Rakshit, 2013):

1. Plasmodium falciparum (P. falciparum).
2. Plasmodium vivax (P. vivax)
3. Plasmodium ovale (P. ovale)
4. Plasmodium malariae (P. malariae)
5. Plasmodium knowlesi (P. knowlesi)

Species of Plasmodium that are typically found in Indonesia is Plasmodium falciparum and Plasmodium vivax[5], Plasmodium malariae sometimes can be found in several provinces, among others, Lampung, East Nusa Tenggara, and Papua. Plasmodium ovale can been found in East Nusa Tenggara and Papua. In 2010, on the island of Borneo reported that P. knowlesi which infect humans where previously only infect primates / monkeys and until now still being investigated [5]. This study did not discuss the detection of Plasmodium knowlesi (P. knowlesi) due to data limitations.

To ascertain the diagnosis of malaria blood clots should be examined. The examination can be done in the following ways :

1. Examination with a microscope
2. Examination of the rapid diagnostic test (Rapid Diagnostic Test / RDT)
3. Examination of the Polymerase Chain Reaction (PCR) and DNA Sequensing

Microscopy is the gold standard for a definite diagnoses of malaria. Microscope examination is done by creating thick and thin blood clots [15].

The life cycle and the development of malaria can be seen in Figure 1. Examination of blood clots thick and thin in the hospital / centre of health / courts to determine [9]:

1. Presence or absence of malaria parasites (positive or negative);
2. species and stage of Plasmodium;
3. parasite density:

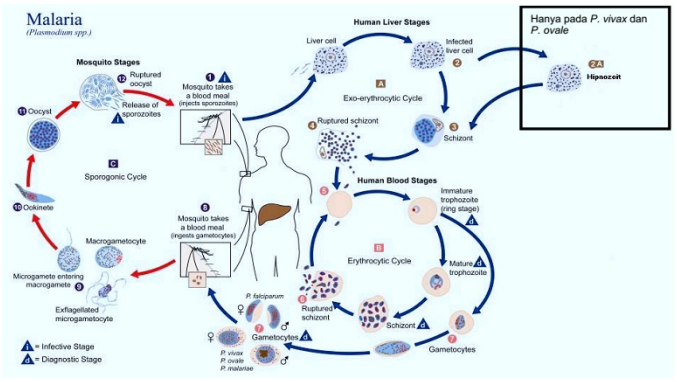

Figure 1 Life Cycle of Plasmodium

B. *Analysis of Medical Image Processing*

Image processing has been widely applied in the field of media or healthcare, ranging from the detection of a disease to modeling for medical purposes [4]. Image processing with computerization is the process of feature extraction meaningful (eg, color, intensity, and geometry groups of pixels) of image, and then summarize and combine the symbolic information into a concept that has been determined, fitting it with a model or sample and a description of the image and analysis of the image that has been processed [16][17].

C. *Histogram*

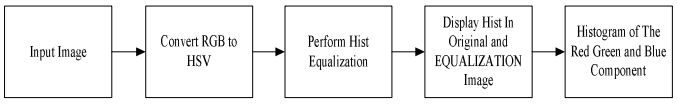

Figure 2. Block Diagram

The original image here is an image of blood taken from patients with suspected malaria. The original image obtained from the original data from hospitals that have been collected will be used in the analysis.

The combination of colors that provide a wide span of colors are red (R), green (G) and blue (B). These three colors are called primary colors (primaries), and is often referred to as the color RGB. Other colors can be obtained by mixing the three primary colors with a certain ratio (although it is not entirely true, because not all the possible colors can be generated by a combination of RGB only), HSV defines colors in terms of Hue, Saturation, and Value.

HSV advantage is that there are colors that are similar to those captured by the human senses. While the colors are formed other models such as RGB is the result of a mixture of primary colors.

HSV has three principal characteristics, namely Hue, Saturation, and Value.

1 Hue: declare the actual color, such as red, violet, and yellow and is used determines redness (Redness), sulfur (greeness), etc.

2 Saturation: sometimes called chroma, is the purity or strength of color.

3 Value: the brightness of the color. Its value ranges from 0-100%. If the value is 0 then the color will be black, the greater the value, the more bright and emerging new variations of these colors.

to get any value from HSV relatively simple, namely:

$$H = \tan\left(\frac{3(G-B)}{(R-G)+(R-B)}\right)$$

$$S = 1 - \frac{\min(R,G,B)}{V}$$

$$V = \frac{R+G+B}{3}$$

Important information about the content of the digital image can be known by making the image histogram. Image histogram is a graph illustrating the spread of pixel intensity values of an image or specific part in the image. From a

histogram can be determined relative frequency of occurrence (relative) intensity of that image. The histogram can also show a lot of things about the brightness (brightness) and contrast of an image. Therefore, the histogram is a valuable tool in image processing work both qualitatively and quantitatively.

III. RESULT AND DISCUSSION

A histogram is a graph showing the frequency of occurrence every color gradation value. The X-axis Cartesian coordinates (abscissa) indicates the level of color and the Y axis (coordinate) indicates the frequency of occurrence. Histogram colors characterize the global distribution of colors in a digital image.

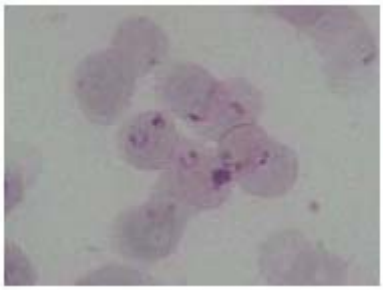

Figure 3. Real Image

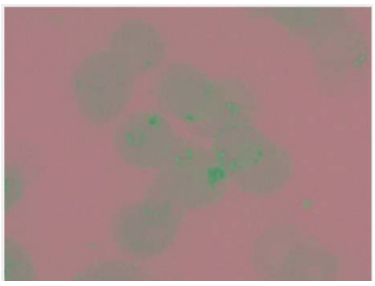

Figure 4. HSV

The composition of colors is one of the features that can be used in image retrieval systems. The composition of colors can be represented in the form of a histogram. The color histogram represents the distribution of the number of pixels for each intensity of color in the image. To define a histogram, color quantization into several discrete levels, then for each of these levels calculated value according to the number of pixels.

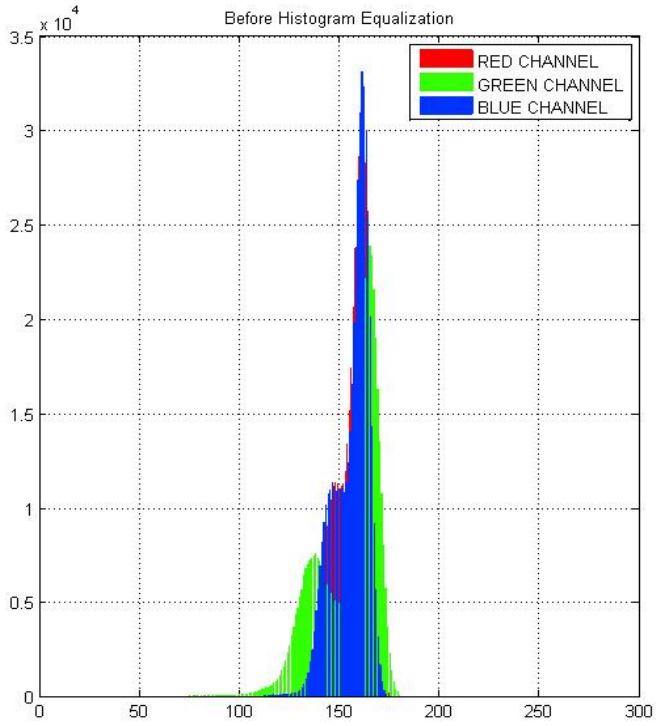

Figure 5. Before histogram equalization

Figure 5 shows that there are more dominant blue color than the other colors. So it means that distribution of blue color are dominant than any other color. Figure 6 shows that the color are more evenly distributed.

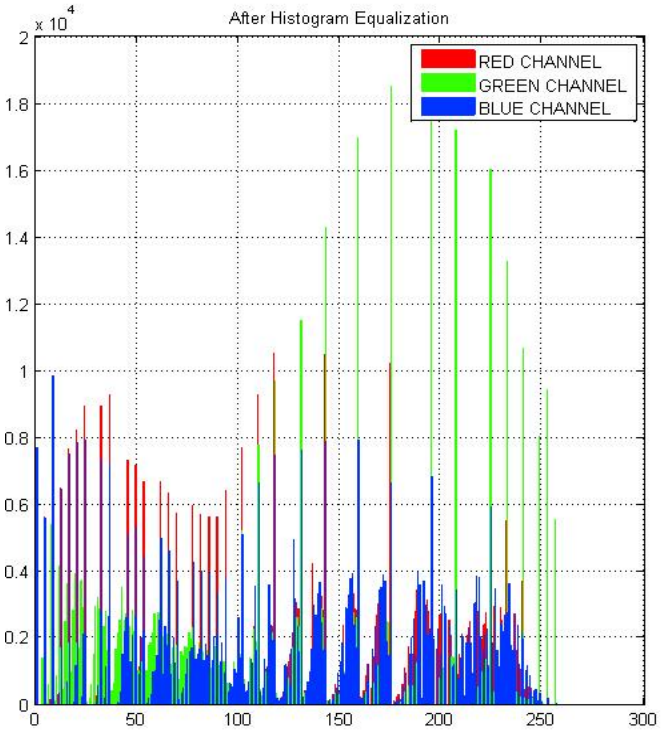

Figure 6 After Histogram Equalization

IV. CONCLUSION

Result of the research, after histogram doing that distribution image spread evenly. The results of this study stated after the histogram on the image that the results are graphed evenly and no dominant, and the image looks more clear.

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