Influence of camera types in histogram distribution on morphological identification of myeloblast cell based image segmentation

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Abstract. A histogram is a graphical display that shows how often the data appears in a data set. In a digital image processing, it becomes necessary to determine the follow-up process to be performed. This paper will discuss the effect of camera types in myeloblast cell identification especially about the effect of histogram distribution on the whole process of myeloblast cell image segmentation. This is a part of our research in identifying white blood cells in the development of computer aided diagnosis for the identification of blood disorders leading to leukemia for rural areas. On the system we are developing, we use the camera as the primary tool in data acquisition. The camera is placed on a conventional microscope. We proposed four types of camera. The result show that camera type 2 has excellent image quality and pixel value. Therefore, in order to develop computer aided diagnosis as a leucocyte classification tool, we recommend to use camera type 2.

1. Introduction
In digital image processing techniques, the role of histogram is quite important. An image histogram is a graph depicting the deployment of pixel intensity values of an image of a particular part in the image. From the histogram can be seen the frequency of appearance of the intensity, brightness and contrast of an image. Refers to variables that can appear on a histogram then it can be known the quality of the image. Image quality is very decisive action to be done on digital image processing techniques. Referring to the description, it can be concluded that the actual root of the problem of digital image processing techniques is image quality. On the other hand, image quality is closely related to the image acquisition equipment itself, in this case is the camera. In our current research, we strive to develop a simple, low-cost and easy-to-use white blood cell identification system for rural areas [1-4]. As discussed in our paper, the input data of our system is the image of white blood cells, especially myeloblast cells produced by ordinary digital cameras. In our study, the camera was placed on a conventional microscope to take pictures of myeloblast cells under study using the microscope. We use conventional microscopy because this equipment is the most widely available at health centres in rural areas. Figure 1 provides examples of the image data we use in this research, which comes from several types of cameras.
Meanwhile, the camera position in the data acquisition is placed just above the observation lens as shown in Figure 2.

In this experiment, we used 4 types of cameras that were divided into regular pocket cameras and cameras on smartphones. We will not mention the brand of the camera, only distinguishes its camera type only. In this paper, we will emphasize our discussion on the effect of camera types on histogram distribution on myeloblast cell morphology analysis. Research on the use of histogram analysis in the biomedical field has also been carried out by several researchers. Chai [5] Chai, in his research proposed the use of histogram equalization in order to take some important parts of the histogram to be combined in a single account called Multipurpose Beta Optimized Bi-Histogram Equalization (MBOBHE). Harris-love [6] in his research aims to estimate muscle tissue echogenicity in older adults through grayscale histogram analysis. Tavakoli [7] in his research studied the contribution of features taken from eye movements in pleasant, neutral, and unpleasant categories in 10 features that should be assessed is a saccade orientation histogram, saccade slope histogram, saccade histogram length, saccade duration histogram, saccade speed histogram, fixation histogram duration, fixation, top-ten prominent coordinates, and saliency maps, gram of saccade duration, histogram of saccade velocity, histogram of fixation duration, fixation histogram, top-ten salient coordinates, and saliency map. Li [8] proposed a new method of histogram equalization with a new approach that takes several parts on the histogram distribution of the MRI image and integrates with the voxel-based morphometry (VBM) procedure. Combine this technique with VBM software and implement it to 62 groups of Alzheimer patients. Arce [9] in his research introduces a method of obtaining cell boundaries automatically and quickly on a digital fluorescent image based on a histogram. Chang [10] in his research developed Sequential Histogram Fitting Algorithm (SHFA) to adjust the variations in excessive and irregular brightness. And adjust the contrast stacked on the image. To do this, the histogram's gray value across the image is calculated and selected one for reference. Then the histogram is slowly changed until the whole turns at the desired value. Jeong [11] in his research presents a method of histogram-based image reinforcement that can assist the radiology in reading bone scan throughout the body in sequence. Schindler [12] in his research analyzed 5 techniques of standardization of intensity in high resolution T1-weighted MP2RAGE image. 20 images with extreme intensity are standardized into representative imagery images. She evaluated with focus on the hypothalamus region, analyzed histogram intensity and actual MR image, and looked for correlations between brain tissue volume and age of the image. Then compare the result with T1 map. Pietka [13] in his research developed a computer aid analysis on hand radiography on bone maturity monitoring based on histograms. Attique [14] in his research proposed two independent methods of new coloring method to show the variability.
in MR brain image and segmentation method to characterize MR gray image. All of them with histogram-based.

2. Methods
2.1. Image Processing
In order to help diagnose doctors to observe the condition of white blood cells, especially myeloblast cells, the image processing is one suitable method for that. Microscopic images of myeloblast cells have a variety of lighting conditions, staining, thickness, shape, uniformity, and density in the blood. These variable differences cause the various attributes of the myeloblast cell image and depend on the type of camera used in the data acquisition. Figure 2 has explained how the position of digital camera in the data acquisition process in this research.

2.2. Object Uniformity and Cell Texture
The uniformity of the object is the similarity of some objects to form a particular class of form, color, type, contour, or shape. The similarity will be the object of grouping of white blood cells and non-white blood cells. Groups that have similarity with white blood cells will be included in the research cluster, and those with insubstantiality will be discarded and considered as noise. While the method used to find a texture characteristic is to use histogram-based analysis.

2.3. Color Space L*a*b
This research used three groups, so that in the process required three kinds of different color region. L * a * b color space mode is used in segmentation with K-Means, this is because the color transformation L * a * b takes only the chromatic color portion of the RGB color space and combines it with luminance. Here is the program snippet to get the color space L * a * b in our experiment.

```matlab
% Make color transformation
cform = makecform ('srgb2lab');
lab = applycform (Img, cform);
```

How the program works above is as follows. RGB image (Img) has 3 layers of red, green, blue. L represents a brightness level (luminance) that has a range of 0 to 100. a * represents the degree of reddish-image of Img that has a range of -100 to 100. Positive values for redness and negative values for greenishness. b * represents a yellowish-blue degree. Which has the same range, where the positive value to indicate yellowish and negative degrees shows the degree of blueness [15]. When the srgb2lab function is invoked with makecform procedure, then applied to Img image, there will be a color conversion from RGB to L * a * b through the equation formula as shown in Equation 1 to 6 as follows:

\[
X = 0,412453 \ R + 0,357580 \ G + 0,180423 \ B \quad (1)
\]
\[
Y = 0,212671 \ R + 0,715160 \ G + 0,072169 \ B \quad (2)
\]
\[
Z = 0,019334 \ R + 0,119193 \ G + 0,950227 \ B \quad (3)
\]

Furthermore, L * a * b * is defined as follows:

\[
L^* = 116f \left( \frac{Y}{Y_n} - 16 \right) \quad (4)
\]
\[
a^* = 500 \left[ f \left( \frac{X}{X_n} \right) - f \left( \frac{Y}{Y_n} \right) \right] \quad (5)
\]
\[
b^* = 200 \left[ f \left( \frac{Y}{Y_n} \right) - f \left( \frac{Z}{Z_n} \right) \right] \quad (6)
\]

The color components L, a, and b are convoluted to produce an image in the column L * a * b.
2.4. Histogram
An image histogram is a graph illustrating deployment of pixel intensity values of a particular image or part in the image. From a histogram can be seen the frequency of relative emergence of the intensity of the image. Histogram can also show many things about brightness and contrast of a picture. Therefore, a histogram is a valuable tool in the job image processing both qualitatively and quantitatively [15]. The image histogram provides many important information as follows: (i) Opportunities of a pixel have a gray degree smaller or equal to a certain degree of grayness, (ii) The peak of the histogram shows the prominent pixel intensity. Width of peak shows the contrast range of the image.

2.5. Camera Types
Digital camera is a type of camera that is widely used today to take pictures of the desired object. This camera produces images that are much better than regular cameras. There are enough types of digital cameras to choose from today. In digital cameras there are several components such as sensor, storage media, LCD screen, black box, lens and also shutter. Sensor on the camera is a sensor used to capture images while the LCD screen is a screen located on the back of the camera used for camera settings. The shutter part of a digital camera is a button to take a picture.

Digital cameras generally have black body and this part does not reflect light. Digital cameras are also equipped with storage media for storing recorded images. But not all digital cameras have in-store storage media so you can use external memory. In the camera the other important part is the lens, this part is translucent to light. The lens on a digital camera has two curved surfaces or one of which is curved. There are quite a lot of types of digital cameras used for shooting. At least there are currently 4 types of digital cameras used for shooting [16], there are: (i) Pocket digital camera; the pocket digital camera is a very practical and easy-to-use camera. This camera is automatic in taking pictures as well as its storage. With features that are still limited then users can get digital photos as you wish. Pocket digital camera is very practical and easy to keep in pocket because of its very small size. (ii) Digital camera phone; is a small digital camera that is placed on the phone. Currently the development of mobile digital cameras is very good up to many smartphones or smart phones that utilize digital cameras to launch their mobile marketing. With the needs of people who like to take pictures with their phones, the presence of mobile digital cameras on the smartphone the better performance. Various brands of smartphones or android phones currently use digital cameras that are very reliable and with excellent technology. This is what makes mobile digital camera skyrocketed and into consideration when buying a mobile phone. The better the camera is on the phone then the more expensive the price of the phone. (iii) Digital SLR Camera; is a type of digital camera that uses pentaprism and also an automatic mirror so that light can be forwarded to the aim of the lens. In this type of camera, the light coming from the lens is reflected by a mirror and then aimed upwards to 90 degrees. After the pentaprism reflected light in the photographer's eyes. (iv) Prosumer digital camera; is a type of digital pocket camera and SLR camera, this type of camera is identical with a camera that is almost the same as a DSLR camera in terms of body. Currently prosumer cameras are very easy to use for shooting both macro shoots, landscape and also for telephoto photos in the open. Referring to the ultimate goal of our research, developing a cheap device in the identification of white blood cells, so in this research we only use 2 types of cameras that are type 1 and type 2 only.

3. Results and Discussions
Referring to our previous research [17][2][3][4] we have already mentioned that the distance the position taken in the image acquisition will affect the image texture analysis results, even in pre-processing it is very influential. Likewise with different types of cameras will provide different image quality as well. Therefore, based on the results of segment analysis, the image is distinguished by its quality into two types, namely the image with good quality, the variables seen are the distance of image taking less close and high image resolution, and image with good quality with closer retrieval
and has a high resolution camera. Results of histogram distribution by type of camera can be seen in Figure 3.

Figure 3 shows the histogram results of four images taken from four different camera types. In figure 3a, the distance capture image is considerable, so the frequency spectrum spread is very small, as in the case of 80-100 on the flat axis. This causes the analysis of the image texture is less precise. Furthermore, the condition also shows the pixel value of the image is too small to be done texture analysis. Image 3a also has a very small contrast value, only about 9000 only so that in distinguishing clusters with each other will be a little difficult and can cause noise segmentation. In Figure 3B, it can be seen that the range of frequency spectrum spread of color is very wide, which is about 50-100 X axis, and has a very high contrast value. This means the image is very good to do image texture analysis and very easy to segment. The wide range also shows a clearly visible color spread, and has a power value of each high-intensity color, which is about 1500 so the texture of the myeloblast cell surface is more clearly visible, and image segmentation will also be freer from noise. Figure 3c has a graphic result that is almost the same as 3b, only in this image the color value of one cluster and the other is not as good as 3b. The intensity range of this image is about 70-120. This means the image is brighter than image 2 despite having the same spread spectrum range. The highest value of energy per image color pixel value is greater than the image type 2 is about 5000 so it will be easy also to be segmented and will be more avoid the noise segmentation. Figure 3d is an image histogram taken from the new data. This image has a yellowish background color. However, if viewed from the form of histogram, the image has a range of intensity spread of each color 60-110 but the largest energy intensity value on the color intensity is smaller. In the morphological analysis, table 1 shows the sample results on morphological analysis based on camera type.

![Figure 3](image1.png)  ![Figure 4](image2.png)

**Figure 3.** Distribution of histogram based on camera type (a) Camera type 1. (b) Camera type 2. (c) Camera type 3. (d) Camera type 4

**Figure 4.** Graph representation of morphological component

| Image    | Area       | Perimeter  | Nucleus Diameter | Cytoplasm Diameter |
|----------|------------|------------|------------------|-------------------|
| Afl1.Jpg | 10754      | 380.288    | 117.015          | 122.553           |
| F0.Jpg   | 243179     | 1902.59    | 556.44           | 1187.88           |
| P2.16.Jpg| 238027     | 1776.66    | 550.514          | 641.602           |

Referring to table 1, it can be seen for an image with an initial name AF having a relatively smaller morphological component than an image with the name P1, P2, or P3. This is due to distance capture, image quality and the value of the camera resolution for image acquisition, greatly influencing the morphological and image texture values. Figure 4 shows the graph of the morphological components of each image.
Referring to Fig. 4, it can be seen that there is a very high spike in some sample data. The highest jump is obtained from the image type 2 which takes the image with a very close distance and has a very high resolution camera value, so it has a very high value on each variable data. But on average, each image variable obtained almost identical results on one type of image. In the image type 1 looks to have the average value of each data is lowest. For image type 3, it is almost the same as the average of each control variable in the image taken using camera 4. That is, even though the type 3 image is taken at close range but the pixel value in the image taken with camera 4 from a longer distance gives same result. It shows the camera 4 can make the acquisition of myeloblast cell image well

4. Conclusions
Based on morphological analysis, the image of each type of camera shows the same comparison results on the image type. When viewed graphically above, the image on camera type 2 has excellent image quality and pixel value, and camera image type 1 has a very low image quality results. This result is comparable to the analysis of segmentation in previous research that camera image type 1 has a poor quality. But the image of camera type 3 and the image taken from camera 4, has almost the same quality value.

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References
[1] Supriyanti R, Afif MM, Hasan IT, Ramadhani Y and Siswandari W 2017 PONTE 73 314
[2] Supriyanti R, Chrisanty A, Ramadhani Y and Siswandari W 2018 Int. J. Elecetrical Comput. Eng 8 150
[3] Supriyanti R, Nababan B L, Ramadhani Y and Siswandari W 2017 A Simple and Easy-to-Use Tool for Detecting Outer Contour of Leukocytes Based on Image Processing Techniques (19th International Conference on Biomedical Applications and Bioinformatics)
[4] Supriyanti R, Satrio G, Ramadhani Y and Siswandari W 2017 J. Phys.: Conf. Ser. 824 012069
[5] Chai H Y, Swee T T, Seng G H and Wee L K 2013 Biomed. Eng. Online 12 1
[6] Harris-Love M O, Seamon B A, Teixeira C and Ismail C 2016 Peer J 4 1721
[7] Tavakoli H R, Atyabi A, Rantanen A, Laukka S J, Nefti-Meziani S and Heikkilä 2015 J PLoS One 10 1
[8] Li X, Messé A, Marrelec G, Pélégri-Isaac M and Benali H 2010 Neuroradiology 52 203
[9] Arce S H, Wu P H and Tseng Y 2013 Sci. Rep. 3 1
[10] Chang S J, Li S, Andreasen A, Sha X Z and Zhai X Y 2015 PLoS One 10 1
[11] Jeong C B, Kim K G, Kim T S and Kim S K 2011 J. Digit. Imaging. 24 424
[12] Schindler S, Schreiber J, Bazin P L, Trampel R, Anwander A, Geyer S and Schönknecht P 2017 PLoS One 12 1
[13] Pietka E, Gertych A, Kurkowska P, Cao F, Huang H K and Gilzanz V 2004 J. Digit. Imaging. 17 175
[14] Attique M, Gilanie G, Hafeez-Ullah, Mehmood M S, Naweed M S, Ikram M, Kamran J A and Vitkin A 2012 PLoS One 7 1
[15] Gonzales R C and Woods R E 2008 Digital Image Processing. 3rd edition (New Jersey: Prentice Hall)
[16] Davis J 2015 The Camera Book (London: Frances Lincoln)
[17] Supriyanti R, Afif M M, Hasan I T, Ramadhani Y and Siswandari W 2017 PONTE Int. Sci. Res. J. 73 314