WBCs detection depending based on a binary conversion of the color component in a Ycbcr color space

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Abstract

Detection of white blood cells (WBCs) automatically is an important issue that has many applications in the field of medical imaging, in this research, we tend to detect white blood cells depending on the Ycbcr color space. The proposed method has been used for the binary conversion of color compounds cbcbr depending on the certain threshold limits. In the experimental results from microscopy images of blood samples, the proposed algorithm was compared with several other algorithms for detection by using a quality scale that compares manual cell count with automatic detection of algorithms where the proposed algorithm obtained a high distinction accuracy reached to 100% compared to other methods.

Keywords: binary image, color space, image processing, Ycbcr transform, WBCs detection.

I. INTRODUCTION

The principle point of using image preparing strategies in clinical field is to copy human assessment. Numerous scientists have attempted to mechanize recognition of platelets from fringe blood smear pictures utilizing picture preparing so as to help hematologists in diagnosing maladies as a choice emotionally supportive network [1]. Cell division is one of the most testing task in clinical picture handling because of its complex organic appearance, recoloring strategy utilized and brightening varieties in gained image [2]. Irregularity in recoloring methodology prompts different degrees of articulation of recoloring [1]. This makes the cells take up changing shading conceals. Microscope Image detection, classification and enhancement technologies have an important role in many applications [3,4,5]. The method disperses cells in step by step diminishing cell fixation over the smear. Since the cells are unevenly appropriated, cells seem dull in the locale of high fixation and pale in the area of low focus. Thus the area in the smear where the picture is procured additionally contributes for shading conceal varieties of cells. The slide under the magnifying lens is lit up by a bulb which brings about brilliance varieties over the smear. Light is more splendid at the inside and diminishes towards the fringe at the given field of view. Consequently a technique for location of WBCs must be sufficiently strong to deal with every one of these varieties. Anyway the vast majority of the strategies produced for computerization expect pictures taken under explicit conditions,. White platelets are a
piece of the safe framework and are created in bone marrow and lymphoid tissues. They secure the body against contaminations, for example, microbes, infections and growths. There are five kinds of white platelets. They are called Lymphocytes, Monocytes, Eosinophils, Basophils and Neutrophils [6]. An overabundance or need the quantity of white platelets may cause different ailments [7]. Analyses of these illnesses are done by blood tests. These blood tests are additionally acted so as to screen the aftereffects of chemotherapy and radiation treatment. At the point when the quantity of WBC is not exactly the reference esteem, it is known as leukopenia. Neutrophils show an expansion in blood in instances of hormonal causes, metabolic scatters, hemolysis and dying. Likewise; microbes, organisms, exotoxin and endotoxin additionally cause the expansion of neutrophils [8, 9]. As referenced over, the quantities of WBC and WBC types are significant in diagnosing numerous maladies. The quantities of WBC and WBC types are gotten by a total blood check (hemogram) test. Fringe smear is a hemogram test. This test depends on recolouring the blood in the wake of spreading it to the magnifying lens slide and afterwards assessing the platelets under a magnifying instrument [10]. WBCs are separated into two gatherings: polynuclear (neutrophil, eosinophil, basophil) and mononuclear (monocyte, lymphocyte). To check the WBC cell types, various techniques are required, for example, deciding the area and ID of the sort in the infinitesimal picture. This procedure is tedious and blunders inclined for a specialist. It is conceivable to diminish the time spent for the conclusion, to lessen conceivable human blunders and to acquire a dependable outcome on account of PC supported programmed discovery and indicative frameworks [11]. Numerous investigations in the writing centre around the arrangement of WBC pictures dependent on cell types. It is the inspiration of this investigation to make the location on the WBC pictures with a locally based convolutional neural system which is one of the profound learning strategies, to characterize numerous phones simultaneously and to group undetectable WBC for reasons, for example, covering or rejection of some piece of the picture. White blood cells [12] (WBC) or leukocytes assume a critical function in detecting various diseases, and therefore, separation of data on this is important for haematologists. Previously, advanced image-setting procedures helped break phones that lead to increasingly accurate, usual and satisfactory analysis frameworks. However, there is some inconvenience in removing information from WBC due to a variety of cells that fit in size, edge, and position. Additionally, since the brightness is unbalanced, the image differentiates between cell boundaries and base fluctuations depending on the condition during the capture procedure. This investigation focuses on WBC division using L2 accurate images. We take a segment of the WBC cores and cytoplasm using a structure created with advanced image setup. The use of image processing procedures has evolved rapidly over the past two years, as blood professionals can use blood images and thus treat blood slides for the main examination in identifying diseases. These methods can assist in detecting naturally occurring cells in human blood, moreover, they can provide data about the ratio of the nucleus versus the cytoplasm to identify different types of white blood cells and their arrangement, for example, neutrophils, basal cells, lymphocytes, Etc. Later, in this paper, we present a proposed system consisting of a few techniques that together comprise basic partitioning and cytoplasm extraction. [13] White blood platelet regulation regulates important indicative data for patients. The count result gives important data about a patient's health and assumes an important function in finding them. Hence, the precise and programmed differential white plate counter is urgent in the examination procedure. The procedure, as a rule, has three stages: splitting the image, including extraction and arrangement. A few professionals recently suggested distinct methods for separating white cells. Ingram and Preston, [14] announced a method of cell identifier based on exceptionally recursive image changes, known as Golay design changes. These changes result in data about cell core properties such as region, edge length, and exact structure. While the third procedure appears with sufficient accuracy, it is relatively late in playing a differential examination. Also, the young man, 141, depicted a strategy using a successive technique based on erythrocyte shading to find white platelets in the field of view.

2. Proposed method for WBCs detection

ycbcrcr color space has an important role in many color image processing applications[15].The WBCs detection method relies on the distinguished of blood cells by using the binary conversion of cb and cr
compounds in the \(ycbc_r\) color space, the binary transform must be include threshold limits. The first step in this method converted image from \(RGB\) to \(Yc_bcr\) color space by using [16]:

\[
\begin{align*}
Y &= 0.299r + 0.587g + 0.114b \\
\text{cb} &= -0.147r - 0.2880g + 0.436b \\
\text{cr} &= 0.6149r + 0.514g - 0.100b
\end{align*}
\] (1)

First equation is a lightness component \((Y)\) and \((\text{cb}, \text{cr})\) are the color components (these components include hue and saturation). And the binary conversion for \((\text{cb}, \text{cr})\) component depending on the threshold values by using:

\[
\begin{align*}
\text{if} & \quad (th1 < \text{cb}(x,y) > th2) \\
\text{then} & \quad \text{bi}(x,y) = 1 \\
\text{else} & \quad \text{bi}(x,y) = 0
\end{align*}
\] (2)

The optimal threshold values are \((th1 = 140, th2 = 160, th3 = 130 \text{ and } th4 = 160\) ), this shown in figure (1-a,b), that is illustrated the original image transformed to a binary image by using threshold limit values. Because to remove of undesirable we used a median filter in the binary conversion with window size \((9\times9)\), by the condition of the volume \((640\times480)\) when the image size is bigger we can give a larger window size:

\[
\text{bi}_{in}(x, y) = \text{median filter}(\text{bi}(x,y))
\] (3)

Figure (1,c) illustrated the binary conversion and the delete of unwanted areas by using the median filter. After this, we convert the image to the binary system by:

\[
\text{Bi}(x,y) = \text{bwboundaries} (\text{bw}_{\text{mn}}(x,y))
\] (4)

Where \(i\) is the number of regions. Where \(\text{Bi}(x,y)\) has a white color, if \(x, y\) is the coordinates of \(\text{WBCs}\) by used [17]:

\[
(x_{wbc} = y_{wbc} = y) \text{ is the coordinate of WBCs}
\] (5)

The coordinates \((x_{wbc}, y_{wbc})\) are matching on the original image to find the white cell region and can be frame sketch in Figure (1,d). The block diagram of the suggested method is shown in figure(2).
Figure (1): An original microscope in (a), binary image in (b), in (c) median filter for b, and detection for WBCs in (d).

Figure (2): Block diagram of WBCs detection algorithm.
3. Quality evaluation

A Quality has been calculated by using the measurement of accuracy between manual counting of white blood cells and automatic counting of discovered cells, based on the proposed algorithms depending on detection rate and false alarm rate. The detection rate (AR) is defined as the ratio between the number of White Blood Cells correctly detected and the number WBCs determined by the expert. That is given by

\[ AR = \frac{\text{wbc corrected auto detection}}{\text{wbc manual count}} \]  

(6)

The false alarm rate (RFA) is defined as the ratio between the number of WBC objects that have been wrongly identified as WBC and the number WBC which have been actually determined by the expert. AFR is determined by [37]:

\[ RFA = \frac{\text{false detection}}{\text{wbc manual detection}} \]  

(7)

4. Results and discussion:

In this study, we suggest a robust method to detect WBCs. The algorithms were tested on microscopic images of blood smears with size 2592 x 1944 pixels. The test was performed using a sample of 60 images obtained from digital camera photography in the same lighting conditions. All algorithms have done by using Matlab (R2018a), a technique for screening white blood cells in images obtained from stained blood samples obtained from the Hematology Center of Mustansiriya University and the Hematology Center in Baghdad Medical Center. Some images illustrated in figure (3). The proposed algorithm identified 70 white blood cells from 70 (at manual account), 100%. The performance of the proposed method as shown in Table 1. To know the detection efficiency, the proposed method was compared with several methods are: Boundary Support Vectors (BSVs) method [18], the Wang algorithm[19], the Iterative Otsu (IO) algorithm [20], Genetic Algorithm-Based method [21] and DE-based detector [22]. This comparison was made by calculating RD and AFR as shown in table 2. We note that the best results of accuracy in detection in the proposed method, followed by DE algorithm and then Wang method figure(3).
Figure (3): Some microscope medical image samples used in detecting WBCs.

Figure (4): Detection in WBCs in the microscope images in figure 3.

Table (1): Quality assessment for WBCs detection by using the suggested algorithm.

| WBC manual count | WBC corrected Auto detection | Error in detection | False detection | AR | RFA |
|------------------|------------------------------|--------------------|-----------------|----|-----|
| 70               | 70                           | 0                  | 0               | 100% | 0   |
Table (2): Accuracy assessment (RD & AFR) for WBCs detection, using many algorithms compare with the proposed algorithm.

| Method  | AR    | RFA   |
|---------|-------|-------|
| BSV[23] | 45.30% | 29.27% |
| IO[19]  | 79.09% | 25.43% |
| Wang[20] | 80.49% | 20.90% |
| GAB[21]| 76.65% | 7.66%  |
| DE[22]| 97.91% | 3.83%  |
| proposed | 100%  | 0      |

5. Conclusion:
In this study we suggest a new algorithm to detect WBCs using microscopic images, by analyzing the results of accuracy the system is so powerful that it is not affected by exceptional circumstances and achieves high accuracy up to 100%. The suggested method compared with several are BSVs, Wang, IO, GAB and DE. Experimental results demonstrate the high performance of the proposed method in terms of detection accuracy, robustness and stability compare with other methods.

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