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Automatic Detection and Quantification of Malnutrition Identification using Iterative Structured Circle Detection Algorithm

N.Vikraman[1], Dr.J.Mohana[2]

[1] *Research Scholar, Saveetha School of Engineering, SIMATS, Thandalam, Chennai, India*
[2] *Associate Professor, Saveetha School of Engineering, SIMATS, Chennai, India*

E-mail: [1]vikramann@rocketmail.com

Abstract: Counting and Segmentation of blood cells are an important step. It helps to extract the features to diagnose the diseases especially malaria, leukemia, anemia and malnutrition. The manual counting of white blood cells and red blood cells in microscopic images is difficult, inaccurate and time consuming process. So this process is very helpful for hematologist experts. It is very useful to perform faster and more accurate result. Here, Iterative structured circle detection algorithm is used for proposed method. This algorithm method used for the segmentation and counting of Wight Blood Cells and Red Blood Cells. The Thresholding method of Image processing is used for separation. Preprocessing step is applied to each and every cell type. The proposed method based on Modified Circle detection, this is used to automatically counting the blood cell images. To solve the detecting irregular circles, selecting the optimal circle, determine the number of iterations and initialization problem, the basic RCD algorithm is used. To determine segmentation accuracy, the validation method is used. It includes, Recall, Precision and F-measumement tests. The proposed method average accuracy is 98.4% for WBCs and 95.3% for RBCs. Based on this result, malnutrition is measured.

Keywords: Blood types, Optical Sensors, Camera, Photo-detectors, Image Processing, Pattern matching, Filters, Malnutrition

1. INTRODUCTION:

The microscopic images is very important in computer science, technology, medical and research fields. Here, the Complete Blood Count tests is used to determine the red blood cell counts, white blood cell counts, platelet counts, haemoglobin(HB) measurements and also the mean of red blood cell volumes. It is used to diagnose, evaluate and monitor the various conditions of the diseases suchas, lukemia, anemia, allergic conditions and infections. In normal blood of human body, the red blood cell counts always will be 4.2 to 5.9 million cells per square centimetre. If high RBC counts shows series medical conditions suchas kidney disease, kidney and lung problems. In normal human being, the WBC count range always will be 4500 to 10000 per microliter. If High White Blood Cell counts i.e above 30000 cells per microlitre then it leads to allergy, lukemia, systemic illness, burn induced tissue injury. If the blood shows abnormal blood smear reading then it will be disease or infection. This paper objective is to identify the malnutrition by automatically count the white blood cell and red blood cell calculated values. Here, the experts can determined the ground truth images. The F-measure and Ground truth measurement method used to identify the accuracy. In the following sections of this paper, we will summarize related work on the segmentation and counting of RBCs and WBCs (Section 2), present the methodology used (Section 3), discuss the results and experiments (Section 4), and review the conclusions.

2. LITERATURE SURVEY & RELATED WORK:

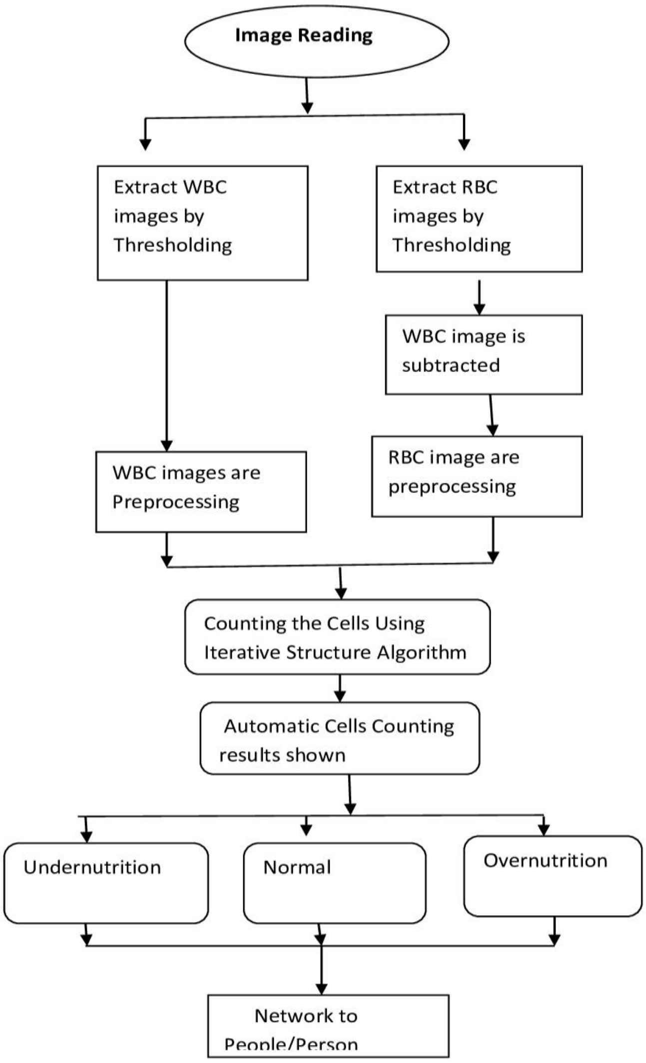
Many researchers have investigated about counting of blood cell and segmentation of blood cell images. Some researchers are used thresholding and morphological operations for counting the blood images and segmentation of the given blood images. Berge et al [5] used iterative threshold techniques and morphological methods. They used the real microscopic images from the lab. The lab expert is using the ground truth. He got 2.8% of the total were found by the manual and automatic count of red blood cells. But here too much of degree overlapping by method tolerated, therefore the cells were unable to detect.

HSV color model with Zack's thresholding technique is used for S and V image components by Damahe et al. Here sequential algorithm is used to increase the segmentation accuracy. Here thresholding is combined to that algorithm. Red Blood Cell is detected in the possessed holes. The accuracy is increased by additional preprocessing steps. Histogram technique is used to findout the optimal thresholding purpose. In 2012, Panchbhai and Vishal proposed RBCs and parasites segmentation from thin smear blood cell images. Here Otsu thresholding is used for infected RBC. But this model is not suitable to detect the overlapping cells and clumped. Here the pathologist is compared to their experimental results with manual counts. Here the optimal thresholding done by histogram method. IN 2011 Rhodes and Bai[12] presented Circle detection using a gabor annulus. Here image features are detected by wavelet filter. The microscopic images allows some degree of overlapping the blood cells. They are using two microscope, that result range were 91.3% and 87% of the blood cells. In 2008, Chung and Huang presented A pruning and voting stategy to speed up the detection for lines, circle and ellipses, this can be applied various shape detection algorithms to enhance the speed of the source algorithm. This method gives excellent results compare than other source method algorithm. Randomized Circle Detection (RCD algorithm) is used to detect the ellipses, circles and lines in the blood images. In 2012, Mahmood NH, Mansor proposed Red blood cells estimation using Hough transform technique, 10 blood image samples were examined. For cell segmentation, thresholding and Morphological operators were used in the S channel. To detect and count the red blood cells Circular Hough Transform is used for investigate the circularity feature. 96% accuracy is obtained from the porposed method compare than manual counting method. Here Hough Transform is very useful to produce the good performance of the result. In 2013, Cuevas E, Oliva D, Azldivar D, Diaz M, Pajares G proposed White blood cell segmentation by circle detection using electromagnetism-like optimization, presented a combination of circle detection but this method tolerated some noises. Here white blood cells are overlapping with small degree. Clumping cells are not tested by this method. But it demonstrated good accuracy results.

3. METHODOLOGY:

The proposed method is developed by counting and segmentation both red blood cells and white blood cells by microscopic images of blood smears. Thresholding and morphological operations is used to segmentation the blood images. Afterthat the counting blood cells based on the circularity feature. The extraction is done by circle detection algorithm. Here the original image is separated into two different set of images. The first image is contains only RBC and another one is WBC image. Thresholding technique is used to separate the images.

The proposed method was developed to analyze microscopic images of blood smears by segmenting and counting both WBCs and RBCs. The segmentation is based on thresholding and morphological operations, and then counting is based on the circularity feature of the blood cells extracted using an iterative structured circle detection algorithm. After cell separation, each WBC and RBC images are preprocessed by morphology operators. The canny operator is used to obtain the edge image. After obtained the edge image, the iterative structured circle detection algorithm is used to count the number of white and red blood cells in each image. Finally, We get the malnutrition data by the blood counting results.

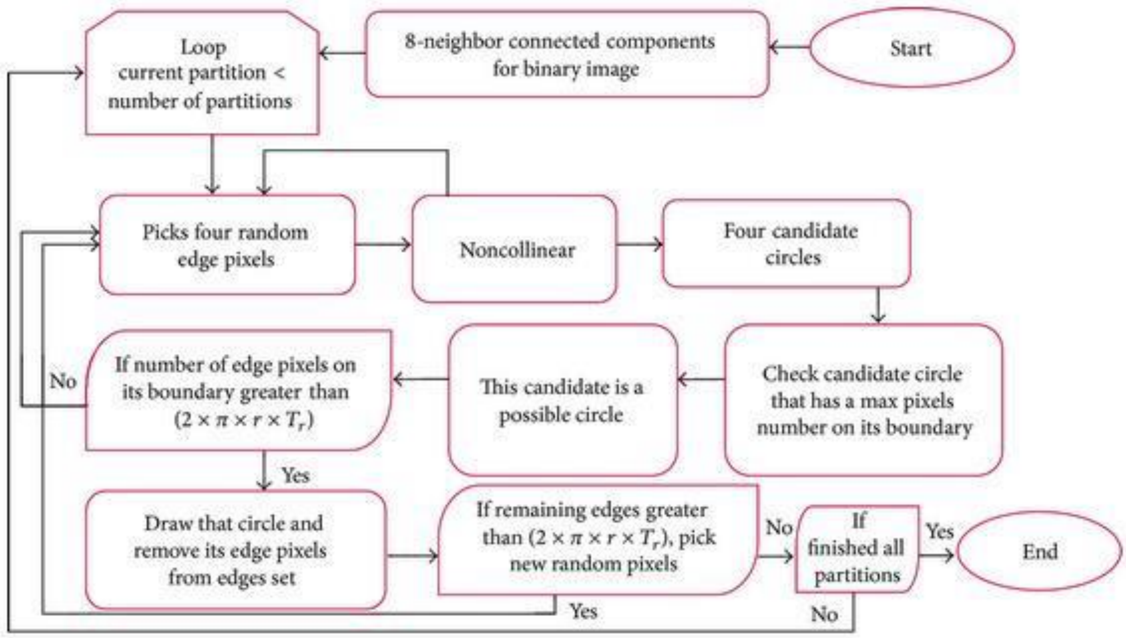


Preprocessing: In proposed method, the RBCs and WBCs cells were separated based on the distinct preprocessing steps and their types.

Preprocessing for WBC: Here, WBCs are extracted into the separate image. Both WBC and RBC have different intensities, so separation process is easy. For removing the RBC, first, the RGB image is converted into its grayscale image by elimate the saturation information and Hue information. But that image retaining its luminance. The grayscale image is converted into binary image by thresholding using 64 threshold value. The cell edges can be visualize by the canny operator. Morphology operator is used to remove the undesired pixels.

Preprocessing for RBC: Here, RBCs are extracted into the separate image. For removing the WBC, the complementary cells are substracted from the original image then the Red blood cells are taken. After removed the WBC, the undesired holes were created. Afterthat, the RGB image is converted into its grayscale image by elimate the saturation information and Hue information. But that image retaining its luminance. The grayscale image is converted into binary image by thresholding using 140 threshold value. The cell edges can be visualize by the canny operator. Morphology operator is used to remove the undesired pixels & fill the holes. After preprocessing steps, this image can be applied to the circle detection algorithm.

Proposed Method – Counting: This idea is derived from the RCD algorithm. It ignores accumulator capability. It is introduced by Hough Transform. The RCD algorithm is used to solve the initialization problem when using the big image size with more number of pixels. It is modified to selecting the optimal circle from the candidate, detect the irregular circle, to identify the number iterations to enhance the algorithm running time and detection, and improving the overlapping cells.



Initialization Problem: Here, the edge image based on 8-neighbor connected to its components. To overcome the initialization problem, we divide the full image into small partition images and these images to employs local randomization purpose, it repeats all partitioning images are visited in the whole images e.g, if one cell is detected in the images then another four pixels from the images are chosen randomly. It continues upto whole partitioning image.

It is based on three noncollinear (v1, v2, and v3) pixels:

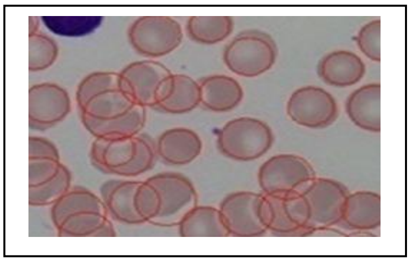
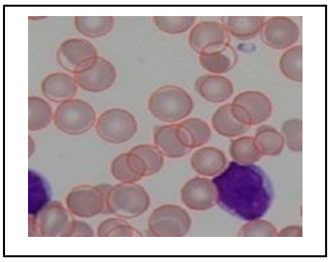
$$(x_j - x_i)(y_k - y_i) - (x_k - x_i)(y_j - y_i) = 0$$

If the result of the above equation is zero, then the three-edge pixels are collinear. These cannot form a circle in the partitioned image. That pixels are returned to the edge array for the particular partition. Then next four new pixels subsequently selected from the same partition for the process.

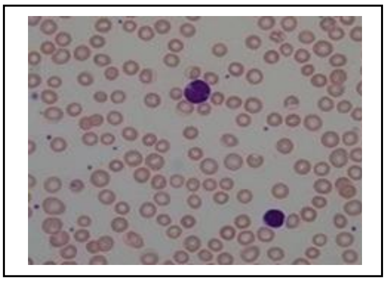
Results of WBC s									
S.No.	**Manual count**	**Proposed method count**	**TP**	**FN**	**FP**	**PR**	**RC**	**FM**	**Over/Normal/ Under Nutrition**
1	117	118	116	1	2	98.3%	99.1%	98.7%	Normal
2	192	199	191	1	8	95.9%	99.4%	97.6%	Over Nutrition
3	53	57	53	0	4	92.2%	100%	96.3%	Under Nutrition
4	15	13	13	2	0	100%	86.6%	92.8%	Under Nutrition
5	99	108	95	4	13	87.9%	95.9%	91.7%	Normal
6	298	350	297	1	53	84.8%	99.6%	91.6%	Over Nutrition
7	73	82	72	1	10	87.8%	98.6%	92.9%	Normal
8	28	31	26	2	5	83.8%	92.8%	88.1%	Under Nutrition
9	41	47	40	1	7	85.1%	97.5%	90.9%	Under Nutrition
10	34	37	32	2	5	86.4%	94.1%	90.1%	Under Nutrition
Results of RBC s									
S.No	**Manual count**	**Proposed method count**	**TP**	**FN**	**FP**	**PR**	**RC**	**FM**	**Over/Normal/ Under Nutrition**
1	2117	2123	2076	41	47	97.7%	98%	97.9%	Under Nutrition
2	2553	2586	2474	79	112	95.6%	96.9%	96.2%	Under Nutrition
3	2484	2529	2443	41	86	96.5%	98.3%	97.4%	Under Nutrition
4	3788	3799	3689	99	110	97.1%	97.3%	97.2%	Under Nutrition
5	4899	5107	4798	101	309	93.9%	97.9%	95.9%	Normal
6	4887	5133	4699	188	434	91.5%	96.1%	93.7%	Normal
7	5195	5228	5007	188	221	95.7%	96.3%	96%	Normal
8	4223	4341	4190	33	151	96.5%	99.2%	97.8%	Under Nutrition
9	4474	4588	4394	80	194	95.7%	98.2%	96.9%	Under Nutrition
10	4974	5044	4842	132	202	95.9%	97.3%	96.6%	Normal

TP – True Positive Value
FN – False Negative
FP – False Positive
PR – Precision
RC –ReCall
FM – F-Measures

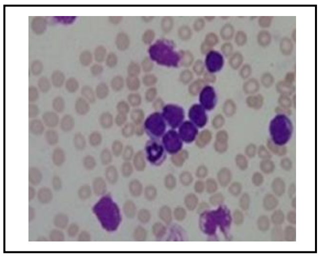
Overlapping RBC Cells Detected in Proposed Method

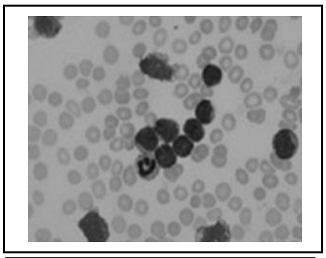
RBC Detected in Proposed Method



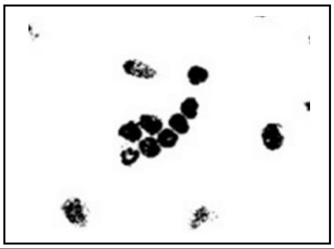
WBC Preprocessing



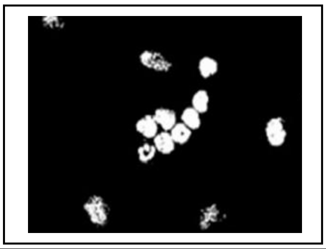
WBC Cells in RGB image format



RGB is Converted into Gray Scale

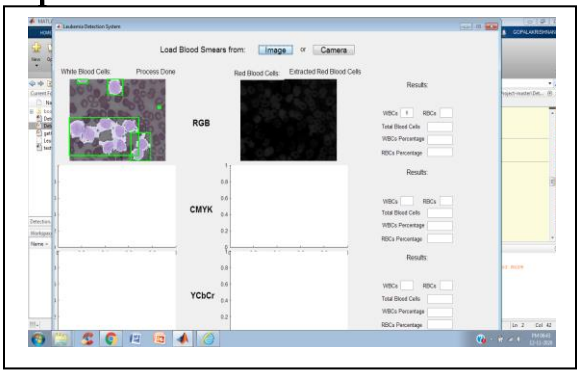


Gray Scale to Binary by Thresholding Method

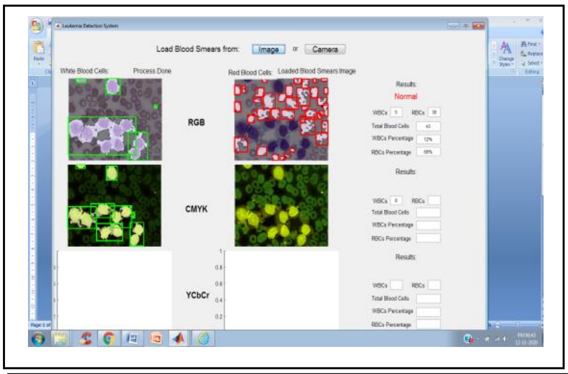


Complementary Image before the holes

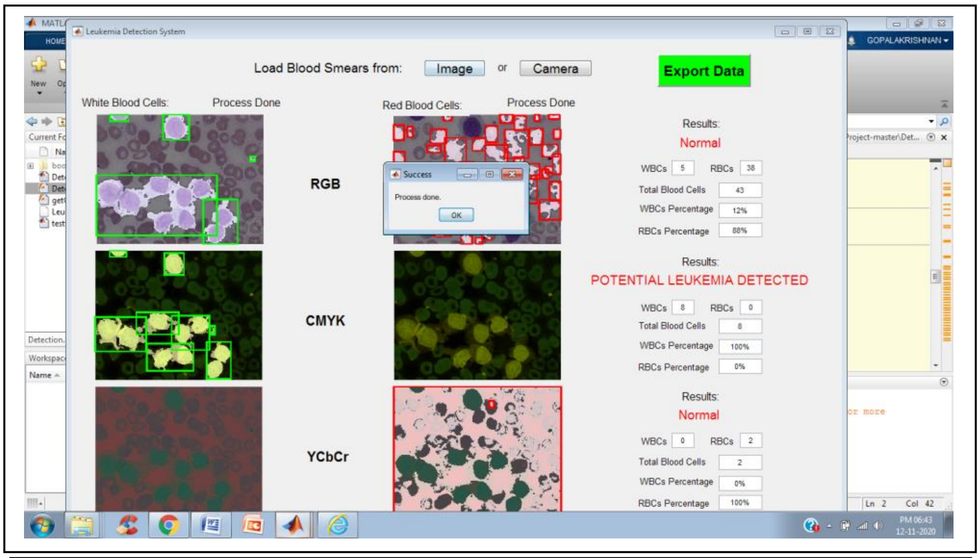
Outputs:



Stage : 1 Input from Image / Camera Blood image



Stage : 2 Processing : WBC and RBC Counted Results



Output - Stage:3

Potential Leukmia Detected

4. RESULTS AND DISCUSSION:

This method is used to make malnutrition free of our country by 2025, by reducing stunting & wasting from our people for easily identification. It can be helpful for better nutritional needs of themselves and the children is key. From this way, too gain better nutritional results for children and women through the community mobilization, integration of technology and greater attention to the urban and rural trends of food consumption market places. AADHAAR card for getting the government plans beneficiary. So finger print is used to register the people’s information. Here, I match the thumb impression to registered AADHAAR number and identify the people to detect the nutrition problem. Children shouldn't be going to bed hungry every night. In addition we identify the link between disease and the level of malnutrition and education. Furthermore, malnutrition affects the educational outcomes. Non-Governmental Organizations (NGOs) and government agencies can play an important role improving the operating and living conditions in the slums, by providing protection to workers, treating diseases, and making quality education accessible.

5. FUTURE WORK:

The idea/method presented in the paper could be extended to any commercial optical equipment like camera, etc. with minor modifications to the device. The technique could further be extrapolated to Smartphone cameras (equipped with image processing or neural networks) for obtaining results at low cost and within a short-time. The „portability‟ factor could therefore add a commercial value to the innovative solution.

6. ACKNOWLEDGEMENT:

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