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Research paper

Diagnoses of Blood Disorder in Different Animal Species Depending on Counting Methods in Blood Cell Images

Kawther H. Al-khafaji[1*], Athraa H. Al-khafaji[2]

[1]*Physics Department, Faculty of Education for Girls, Kufa, Iraq.*
[2]*Resident Veterinary Doctor, Kufa, Iraq.*

Abstract

Counting of red blood cells (RBCs) in microscope blood cell images, can give the pathologists valuable information regarding various hematological disorders, like anemia, leukemia,....etc. in several animal species, in this paper, an automated vision system has been developed which is capable of counting of red blood cells, in blood samples by applying different algorithms, based on red blood cellshape, the difference in the red blood cell shape of animal species make it difficult to use a one algorithm, therefore, for each animal species used specific algorithm which was capable of counting of RBCs effectively.

Keywords: *Red blood cells, image processing, RBCs counting, animal erythrocytes.*

1. Introduction

Blood is becoming a significant diagnostic tool in veterinary medicine, globally. The animal blood image provides an occasion to investigate the appearance of several metabolites and other components in an animal body, and it plays a necessary role in the "estimation of physiological, pathological and nutritional status of an organism". It also helps to recognize the normal state from the state of stress, which can be environmental, physical or nutritional. [1]

Erythrocytes "RBCs" are the most common "regular" type of blood cell, the vertebrate organism's principal means of transference oxygen O_2 to body tissues by take up the oxygen in the gills or lungs and release it into the tissues through the body capillaries.[2]

Blood cell count(RBCs) reports are the most common tests taken on the recommendation of the veterinary doctor. It is well known that a diversity of factors such as breed, species, sex, age, nutrition, stress, illness, transport, and seasonal variations could impact in the profile of these values.[1]

Image processing based computer vision applications use many different areas .In one of the works carried out for this purpose, image processing is used for object counting[3][4].In this paper, the RBCs in microscopic medical images represent the object to be countaccurately, where, counting and classification of blood cells allow the evaluation and diagnosis of many diseases.

In this paper, different forms of red blood cells are studied according to the animal species, The entire suggested algorithms have been designed by using MATLAB.

2. Red blood cell count level disorder

a) In case of RBCs count are higher than a normal, this possibly due to:"dehydration, polycythemia vera, congenital heart disease, renal cell carcinoma, pulmonary fibrosis".[5]

b) In case of the number of RBCs are less than a normal it possibly caused by:"bone marrow failure, anemia, erythropoietin deficiency RBC destruction, leukemia, bleeding, malnutrition, multiple myeloma, nutritional deficiencies".[5]

c) Certain medication can also lower RBCs count, especially: "chloramphenicol, quinidine, chemotherapy drugs, hydantoins".

3. Blood sample collection

The blood sample that gathered from all five animals (Camelid, Caprine ,Canine, Birds and Fish)as follows**:**

Table 1: Survival Blood Collection

Animal Species	Blood Sample Collection Site
Camelid	Jugular vein, The lateral thoracic vein or caudal epigastric vein.[6][7][8]
Caprine	Jugular vein, Cephalic vein, cardiac(non-survival blood collection). [9][10]
Canine	Jugular Vein, cephalic Vein, lateral Saphenous Vein, Femoral vein/artery, carpal pad/ear pinna, cardiac(non-survival blood collection) aorta. [11][12]
Birds	Right side jugular vein ,brachial (alar, ulnaris) vein, femoral vein, medial metatarsal vein, cardiac(non-survival blood collection), occipital sinus(non-survival blood collection).[13][14][15][16] [17]
Fish	Posterior caudal artery and vein, cardiac, gills, tail vein.[18]

4. Blood smear preparation

After the blood sample was taken, the next step is making a blood film in a slide-to-slide method. EDTA-anticoagulant blood must be used to prepare a blood smear in order to minimize the degenerative changes of the blood cell. then by putting the slide under the microscope lens to allow the several blood cells to be tested microscopically. to look for blood parasites and investigation of blood disorders .

5. Animal erythrocytes (RBCs) shape in difference species of animal

Table 2: Red Blood Cells Morphology in Different Animal Species

Animal Species	Erythrocytes Morphology
Camelid	RBCs in Camelid are "oval shaped instead of round", in consequence of that, their blood cells are capable to expand to around 240% of its primary volume, this extended shape of their RBCs also allows the ease of moving in thick blood and narrow blood vessels. [19][6][7]
Caprine	Caprine RBCs are may be observed as "sphere-shaped red cells", discoid with 2.5- 3.9pm of width, with lifespan about 125 days. The disc shape of RBCs expedite gas exchange. The diameter of blood cell in goat about2.5 pm, while in sheep about 4.5 pm.[20][21]
Canine	Canine RBCs "relatively large, uniform, a round disc, with no nuclei, no organelles, biconcave with a central pallor ", The canine erythrocyte lifespan varies from 110-120 days. Dog RBCs are "bigger relative to other species, with diameter varies from 6 to 8µm", Generally, young dogs have greater red blood cell counts than adults; males have greater red blood cells than females. [22][23]
Birds	Bird RBCs are "oval cells with a central nucleus that stains dark blue". The cytoplasm normally "stains a pink-orange colour". The young RBCs begin as round cells that have a medium blue nucleus and cytoplasm with light blue color. RBCs have a centrally located nucleus. When the RBC matures, it takes an oval shape, the cytoplasm color exchange from blue to the orange.[24]
Fish	Fish RBCs are "oval in shape with abundant smooth eosinophilic cytoplasm and a central oval-shaped nucleus". Cell size varies greatly with species.[25][26]

6. Blood cell counting methods

blood cell counting personified an important role for the veterinary to diagnose various animal diseases, manual blood cells counting device, it was specially designed for a total blood cells count, but there were some drawbacks in performance of mechanized methods, it cannot detect the variation in the shape or size of blood cells, and is considered an highly monotonous, costly, time consuming and leads to inaccurate and incorrect results caused by human error, hence, it is essential to search for a new to RBCs counting procedure, and it's done by applied counting algorithms, to evaluate the number of RBCs. [27] [28]

7. Design and implementation

To count the RBCs for Camelid in the microscope image, an algorithm has been proposed and developed, the flowchart of the proposed method is displayed in Figure.1, the algorithm has the following stages:
Step 1: Image Loading.
Step 2: Read Microscope Medical Image.
Step 3: Image Enhancement .
Step 4:Input Count Function.
Step 5: Find Connected Components in Binary Image.
Step 6: Show the Obtained Result by MsgBox.

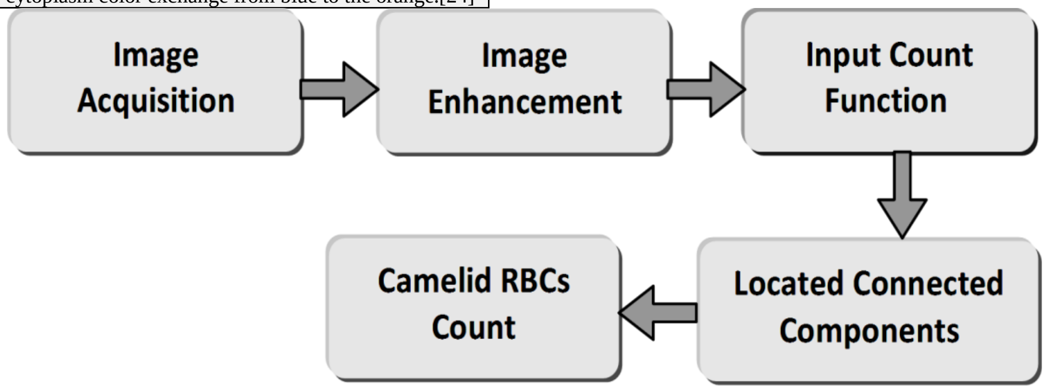


Fig. 1: Flow chart of camelid RBCs count methodology

To count the RBCs for Caprine in microscope medical images, a new algorithm have been proposed and developed, the stages of the algorithm are clearly shown in Figure.2 as the following:
Step 1: Image Loading.
Step 2: Read Microscope Medical Image.
Step 3: Convert RGB Images.
Step 4: Convert Image to Binary Image, Based on Threshold By.
Step 5: Finding the Center and the Radius of the Blood Cell in the Image.
Step 6: Excretion the Cells Outline and Center in Binary Image.
Step 7: Input Count Function
Step 8: Find Connected Components in Binary Image.
Step 9: Show the Obtained Result by MsgBox.

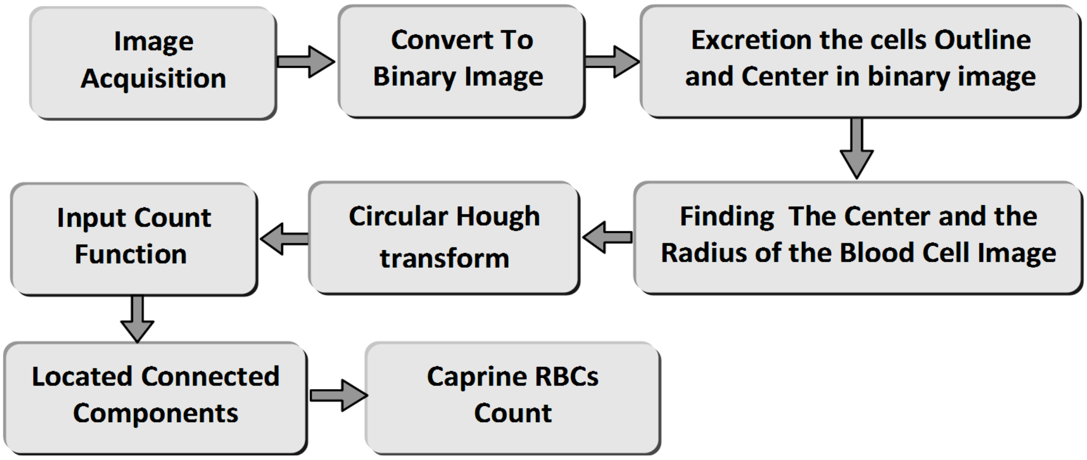


Fig. 2: Flow chart of caprine RBCs count methodology

To count the RBCs for Canine and Birds and Fish in microscope medical images, a new algorithm have been proposed and developed, the algorithm has the following stages:
Step 1: Image Loading.
Step 2: Read Microscope Medical Image.
Step 3: Convert RGB Images.
Step 4: Convert Image to Binary Image, Based on Threshold.
Step 5: Fill Microscope Image Regions and Holes.
Step 6: Numbering of Each Cell in the Binary Image Microscopic Blood Cells.
Step 7: Measure Properties of Image Regions.
Step 8: Input Count Function.
Step 9: Find Connected Components in Binary Image.
Step 10: Show the Obtained Result by MsgBox.

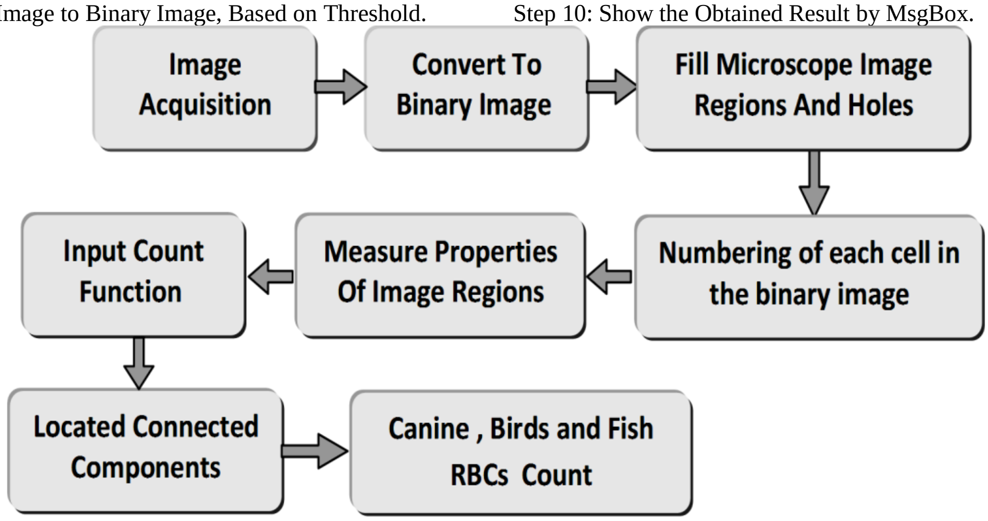


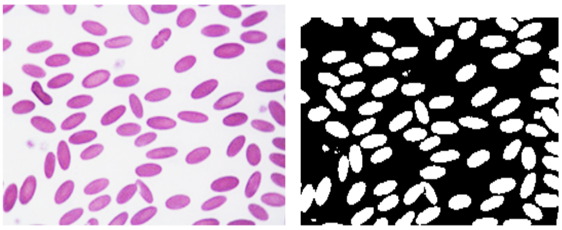
Fig. 3: Flow chart of canine, birds and fish RBCs count methodology

8. Results and discussion

As aforementioned, to distinguish the multiple animal diseases, it can be verified only from observing the blood cell number, therefore, this research presented different algorithms to count the RBCs, in consequence, the animal blood disorder has been diagnosis. The experimental result is listed in the table(2) which represented the count number of RBCs that had counted in two ways manual counting and computer counting, for all five animal species. Red blood cells demonstrated by white and the background in black in all resulting images.

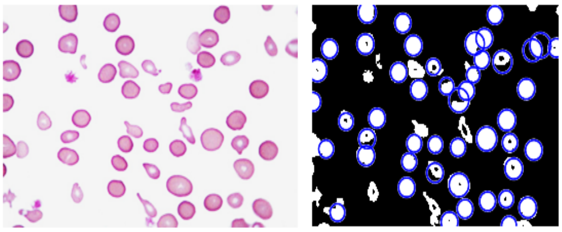
Table 3: The Result of RBCs Count by the Proposed Method

Animal spp	Number of Red Blood Cells	
	Manual Counting	Computer Counting
Camelid	79	86
Caprine	60	57
Canine	84	89
Birds	116	122
fish	123	146



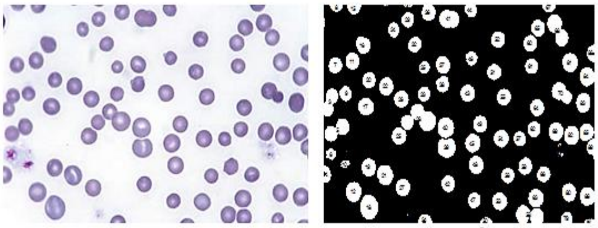
-a- -b-

Fig.4: Microscope Camelid blood cell image (a) the original image,(b) the output



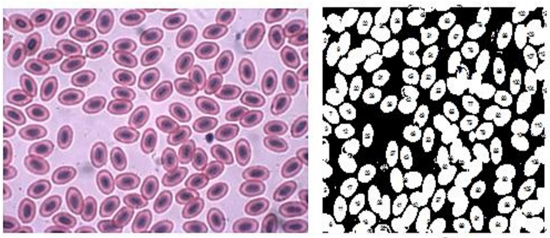
-a- -b-

Fig.5: Microscope Caprine blood cell image (a) an original image,(b) the output image.



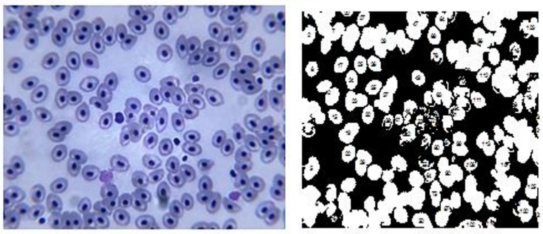
-a- -b-

Fig.6: Microscope Canine blood cell image (a) an original image,(b) the output image.



-a- -b-

Fig.7: Microscope Birds blood cell image (a) an original image,(b) the output image.



-a- -b-

Fig.8: Microscope Fish blood cell image (a)an original image,(b) the output image.

9. Conclusion

Due to the inaccuracy of counting results in the traditional methods, so it was used computing methods in counting. which they based on the use of different techniques including Hough transform technique. As a conclusion, the algorithms were successful in counting the number of red blood cells, despite the irregular RBCs shapes of animal species. Proposed algorithms of RBCs counting was fast, cost-effective, time-reducing and gave precise results. Furthermore, Veterinarians have been able to diagnose diseases better, because of the accuracy of the counting results.

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