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Intelligent Blood Cell Classification Using Machine Learning Algorithm

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***Abstract*—** This paper is an attempt to distinguish the blood cells into classify between White Blood Corpuscles (WBC) and Red Blood Corpuscles RBC to further this classification to find the sickle cell detection. The sub categorization of the red blood corpuscles is an important implementation in this paper for the disease classification. The sickle cell anemia is a disease based on RBCs oxygen carrying capability. In order to avoid the misclassification the RBC sub-categorization is carried out. The sickle cell anaemic cells are found using the machine learning algorithms. The convolutional Neural Network based implementation is carried out to find the sickle and non-sickle cell RBCs. The results obtained are found to be satisfactory.

***Keywords*—**Sickle Cell Anaemia, Convolutional Neural Network(CNN), Deep learning Methods

I. INTRODUCTION

Sickle cell disease (SCD) is a collection of blood syndromes characteristically comes from a person's parents. The most public type is recognised as sickle cell anaemia (SCA). It causes an irregularity in the oxygen-carrying protein haemoglobin developed in red blood cells. This clue to an unbending, sickle-like form in some conditions. Issues in sickle cell disease start from five to six months of age. Number of health issues can also develop "sickle cell crisis", anaemia, bacterial infections and stroke. People may get older because of this long-term pain. Hence the average life of expectancy is 40 to 60 years in the world.
Sickle cell disease develops if a person inherits 2 sets of this gene which are abnormal, one from each parent. This gene occurs in chromosome 11. Several sub-kinds exist. Because of the temperature changes, stress, dehydration and high altitude an attack can set off. This kind of issue is called as sickle cell trait. Those kinds of people are also considered as carriers. Resolving is by a blood test, and some countries they test all babies at birth time.

To care the people who have sickle cell disease may also include prevention of infection with the available methods. Other methods include blood transfusion and the Medication hydroxycarbamide. Few people can be cured by a transplant of bone marrow cells.

II. RELATED WORK

These disorders are genetic blood diseases caused due to inheritance of abnormal hemoglobin genes from both. Every year more than 300000 children born with this disorder. SCD is differentiated by changing the shape of these blood cells from a donut-shape into a crescent shape which resists the blood flow. This situation leads to anemia which is called sickle-cell anemia. This disorder containing people have typical hemoglobin S molecules, which distorts red blood cells into a sickle shaped cell. Thalassemia is also inherited blood disorder [2]. Presence of tear drop cells (dacrocytes) in blood indicates chances of beta thalassemia in a patient. These tear drop cells can be found in beta thalassemia major, especially after splenectomy. Dacrocytosis can be related with myelophthisicanaemia, commonly caused by myelofibrosis [3]. Elliptocytosis, also called as ovalocytosis, is a hereditary blood disorder. In this disorder red blood cells will change its shape. This type of distinctive erythrocytes is occasionally called as elliptocytes. In these severe forms, this disease predisposes to hemolytic anaemia. Decrease in these cells' elastic nature is main for the pathophysiology of the infamous sickle-cell disease. Usually these cells are elastic which flows through capillaries smoothly. In this disease, low oxygen count which promotes the sickling of red blood cells. These cells will not be successful to come back to its original shape after the oxygen tension is recovered which is normal. As an output these rigid blood cells are not able to deform. Healthy red blood cells function for 90–120 days, but these cells only live for ten to twenty days [4]. According to the CDC, thalassaemia is usual in people from Asia, Middle East, Africa, and Mediterranean countries such as Greece and Turkey [5]. The method for testing sickle-cell disease and thalassaemia is to observe a patient's blood sample. The literature [11] details about the sickle cell anemia screening method. It takes more time and trained professional to examine visually to give the results. To detect the various kind of distorted cells separately by human vision

is very difficult. So this procedure is to be devised that makes detection is easy, fast and low cost. The main aim of this paper is detection of various kinds of abnormalities like sickle shaped cells, dacrocytes and elliptocytes using CNN classifier.

III. METHODOLOGY

Feature extraction based on colour Histogram with CNN Classifier is introduced. The resolution of blood-based diseases includes differentiating patient blood samples. These data consists of 12,500 augmented JPEG images. There are nearby three thousands images, based on cell kinds grouped into four folders. The cell kinds are Eosinophil, Lymphocyte, Monocyte, and Neutrophil. There are nearby three thousand images which are augmented for every class of the 4 classes which is compared with 88, 33, 21, and 207 images of each in folder 'dataset-master'.

Convolutional networks were motivated by biological processes in that the connection method between neurons resembles of the animal visual cortex. CNNs use comparatively pre-processing with the other image classification algorithms. The major advantage is the independency from the earlier knowledge & effort of human in feature design. The flow diagram of the implementation is given in the following figure1.

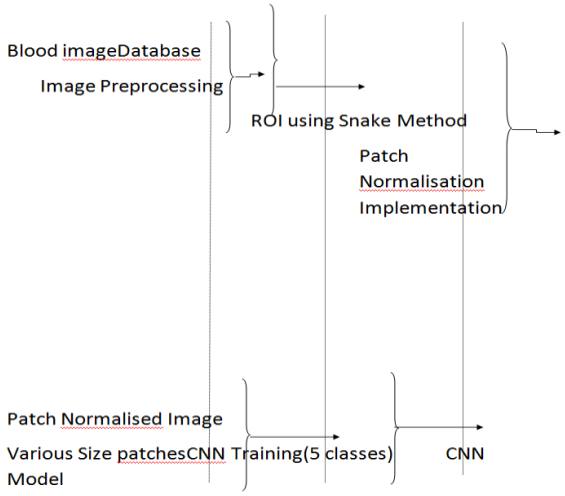

Figure 1. The flow Diagram

IV. RESULTS AND DISCUSSION

The Python Keras based implementation is carried out on the images from these blood cell dataset and the results are obtained after classification. The CNN based classification algorithm is carried and the results are obtained and found that the types of the RBC and WBC are satisfactory and the input for the sickle cell anemia is obtained from the algorithm. The classes that are chosen as main class are based on the red blood cell kinds and the other one is the number of nucleus available in the blood cells. The class 1 which tells about the types of the different red blood cells includes Discocytes, Granular, Elongated, Oval and Sickle Cell and for the class 2 it includes sub categories including the number of nucleus in the cells and classified as Mononuclear and Polynuclear.

In the overall dataset the number of cells that are of different RBC type is mentioned in the Figure 2.

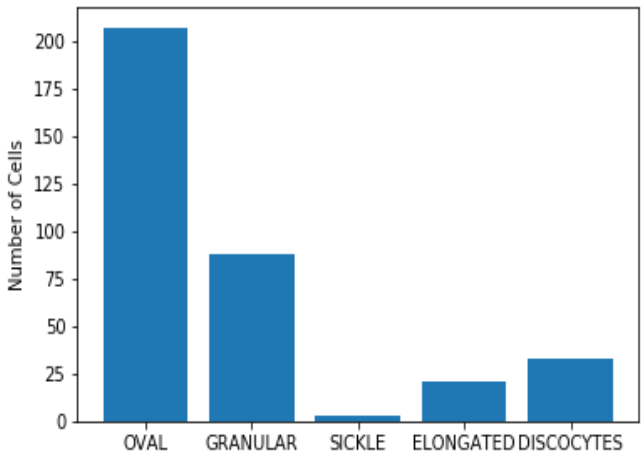

Figure 2. Different shapes of RBC and their population in the Dataset

The patch removal using the ROI snake method is carried out and the histogram of the patch thus taken into account is taken and the CNN is applied on the feature thus obtained. The cells thus obtained are used for further analysis as per the flow diagram. The output gives WBC, RBC and the platelets are as shown in the Figure 3.

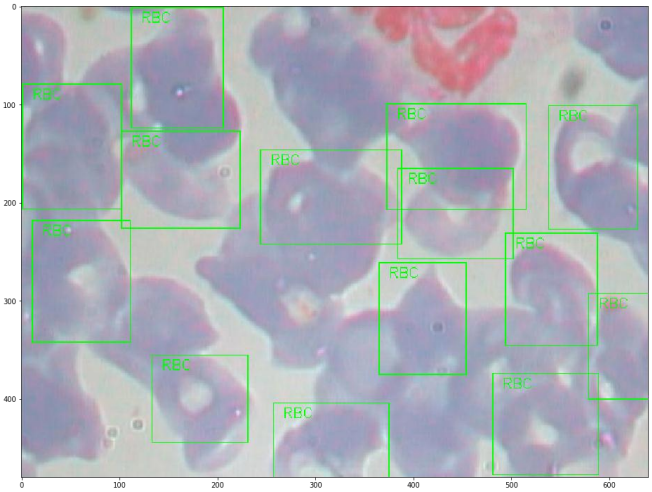

Figure 3. Classification of WBC, RBC, and Platelets.

The histogram that is needed for the classification of the different kinds of RBC and the different number of nucleus is as shown for a sample image. The histogram thus obtained is utilized to visualize or to classify the type of RBC and also to finalize the number of nucleus in the blood cell.

The figure 4 defines the chromatic histogram of the cells under scrutiny which is the feature extracted for the classification problem.. CNN based classification is carried out and the results are discussed.

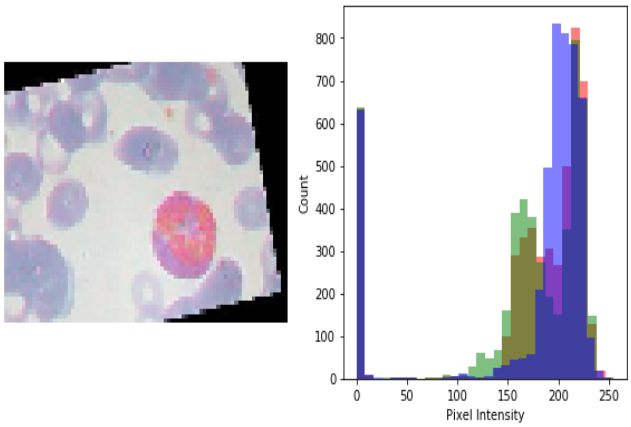

Figure 4. Histogram for a sample Image

The feature extraction and the Keras based classification is carried out on the blood cell images and the results are obtained. The results obtained 80% accuracy while validation process.

V. Conclusion and Future Scope

The paper deals with the blood cell classification algorithm using the CNN algorithm and the results are found to be satisfactory. The classification of Discocytes, Granular, Elongated, Oval, and Sickle Cell is classified in the implementation.

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Ms. Shwetha S Patil currently pursuing Masters of Technology in Data Engineering and Cloud Computing from REVA University, Bangalore, Karnataka. Year of pass out: 2019, Passionate about Machine Learning and applications.

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