RED BLOOD CELLS SEGMENTATION AND ESTIMATION

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Specially dedicate to…

My beloved wife, son and family

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ABSTRACT

The erythrocytes are the most numerous blood cells in human body and it also called red blood cells. The number of red blood cells contributes more to clinical diagnosis with respect to blood diseases. The aim of this research is to produce a computer vision system that can detect and estimate the number of red blood cells in blood sample image. The proposed system takes an input, color image of stained peripheral bold smear images. Since the object of interest is the red blood cells, the system is capability to detect or differentiate between the red blood cells with other blood cell based on size of object. In order to detect red blood cells, the segmentation and extraction step must come early before proceeded to the detection process. In addition this system also can provide the capability to estimate the number of red blood cells. This process is based on the circle detection process by considering that the red blood cells always in normal radius and circle shape of red blood cells. Thus, the result presented here is based on images with normal blood cells. The tested data consisting 20 samples produced the accurate estimation rate close to 96% from manual counting.

ABSTRAK

Sel-sel darah merah atau ‘erythrocytes’ merupakan antara kumpulan darah terbesar di dalam badan manusia. Jumlah bilangan sel-sel darah merah dijadikan penanda aras di dalam rawatan klinikal untuk menentukan berlakunya penyakit yang berkaitan dengan darah. Matlamat penyelidikan ini adalah untuk menghasilkan satu sistem berkomputer yang boleh mengesan dan mengira jumlah sel-sel darah merah di dalam sampel imej darah. Sistem ini menggunakan sampel imej dari kaca mikroskop. Sistem ini hanya fokus kepada sel-sel darah merah sahaja, maka sistem ini berkebolehan untuk kesan atau membandingkan sel-sel darah merah dengan sel-sel yang lain berdasarkan saiz sel-sel tersebut. Dalam proses untuk mengesan sel-sel darah merah, segmentasi dan pengekstrakan perlu dilakukan terlebih dahulu sebelum melalui proses pengesanan. Sistem in juga berkebolehan untuk mengira jumlah sel-sel darah merah. Proses pengesanan ini berdasarkan mengenal pasti lingkaran objek dengan menjadikan normal jejari dan bentuk lingkaran sel-sel darah merah. Oleh sebab itu, keputusan yang diperolehi di dalam sistem ini adalah berdasarkan imej darah yang normal. Eksperimen ini menggunakan 10 sampel imej darah dan kejituan sistem ini hampir 96% daripada pengiraan secara manual.

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WBC	-	White Blood Cell
RBC	-	Red Blood Cell
SMV	-	Support Vector Machine
MLP	-	Multilayer Perception
GUI	-	Graphical User Interface

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Blood is a liquid tissue, which consists of three major cells in our blood, which are white blood cells (WBCs) or leukocytes, red blood cell (RBCs) or erythrocytes and platelets or thrombocytes. In an adult man, the blood is about 1/12th of the body weight, and this corresponds to 5-6 litres.

The erythrocytes are the most numerous blood cells in human body, and it also called red blood cells. The red blood is a blood that functioned as a carry oxygen throughout our body [1]. According to American Cancer Society (2009), the normal red blood cell in our body is divided into four categories of ages, which are newborn, children, women and men. The average amount of red blood cells each category is about 4.8-7.2 million per cubic millimeter, about 3.8–5.5 million per cubic millimeter, about 4.2-5.0 million of these cells per cubic millimeter and 4.6-6.0 x 10^6 per cubic millimeter respectively.

Red blood cells which are the ability to carry oxygen are measured by the amount of hemoglobin in our blood. If our level of hemoglobin is low, we are anemic and our body works much harder to supply oxygen to our tissues. This can make we feel fatigued and short of breath. In some cases fatigue becomes so severe that you must temporarily halt your treatment or reduce the dose you receive. Anemia can be relieved with a blood transfusion or with medication to increase your body's production of red blood cells [2].

The effect of having high red blood cells in our blood is it can be an indication of an undetected heart or lungs problems. When any of these organs is not functioning properly, then blood oxygen levels go down. In order to normalize oxygen supply, the body increases its production of red blood cells.

Counting of red blood cells in a blood sample can give the pathologists valuable information regarding various hematological disorders. Since the classical method for diagnosis of red blood examination in a blood sample is counted by manpower, it has are the following deficiencies such as poor reliability, low efficiency and strong subjectivity. The diagnosis is the process of finding out what kind of disease a certain patient has and this diagnosed must always be accurate. A wrong diagnosis may lead the situation and condition of a patient become worst and some case, patient die due to wrong dosage of drugs given [3].

In the process of estimating red blood cells on blood sample images requires four steps. These steps are acquisition, segmentation, feature extraction and estimation. The acquisition step is done by taking the images that ready for analysis. Then the both segmentation and feature extraction is done by using a morphological technique in order to distinguish the red blood cells from background and other cells. The last step is estimating the number of red blood cells, and it has been done by using Hough Transform technique.

1.2 Problem Statement

The classical method of red blood examination in a blood sample is counted by manpower, which has the following deficiencies such as poor reliability, low efficiency and strong subjectivity. In order to overcome that weakness, some researchers have done some useful works [4-5]. The overlapping of clumped red blood cells each other, it also results in the problem in counting process. This project studies and develops the algorithm and creates user-friendly software to counting the red blood cell automatically in blood cells.

1.3 Objectives

The main objective of this project is to develop software or algorithm for the purpose of detecting the red blood cells in a blood sample. In order to detect the red blood cells of these blood samples, the software should have a capability to estimate the number of red blood cells in the image sample which will be taken by a microscope. In addition, this system should also have a capability to classify the red blood cells from other cells in blood samples before counting process starts. This is done by making sure that the algorithm can achieve high accuracy and high performance.

1.4 Scopes of the Work

In this study, there are scopes that need to consider in order to make this project can work accordingly to the objectives. The scopes are:

1. The program obtains image sequences (input) from the computer (offline).
2. Investigating the different between red blood cell and another cell in a blood sample.

3. Analyses the contour of red blood cell and segmented them.
4. Normal shape of single red blood cell will be considered.
5. The object of interest then should only be red blood cells and not any other cells.
6. Matlab is used to develop the software.

1.5 Significance of Study

Through the well study, it creates a path of idea on how to extract and counting the red blood cells inside the blood sample image. Besides that, it gave the user-friendly and practical approach to help a medical person in diagnosed the blood sample of a patient.

1.6 Thesis Overview

This thesis consists of five chapters. Each chapter has its own discussion on the aspects related to the project. The following are basically the aspects discussed in each chapter.

Chapter 1 discusses the introduction, objectives, scope and significance of the project. Moreover, it also describes briefly the general introduction on the environment and specifies the object of interest. Chapter 2 provides literature review of another research and published technical paper of the previous project that related to this project, and method approached for segmentation and estimation red blood cells.

Chapter 3 focused on the methodology, theory and approaches in building the project. This chapter reviews algorithm and design concepts, and its functionalities are explained. It also described design, work flow and methodology. The result and discussion are presented in Chapter 4. This chapter includes the basic usage guide on the system and comparison of manual results and system results. Chapter 5 deals with the summary and conclusions of the project. Some recommendation and suggestions for the future development of the project are also discussed.

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