A New Algorithm for Red Blood Cell Characteristics Image Recognition

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***Abstract*—Blood cells characteristics recognition is an important issue for food nutrition. Food scientists want to know the detailed information of fish red blood cells, such as the major axis of a cell, minor axis of a cell, overlap rate of a cell. It would determine the scale of agglutination of red blood cells. That means the more fatigued a fish, the more agglutination of red blood cells there are. In the animal model, we determine if a medicine significantly outperform control groups via death rate of fishes within a certain number of days. In this study, red cells characteristics levels approach was proposed. It means that the fishes would die at a lower rate than the animal model due to red blood cells image recognition replacing death rate of fishes. Previous researches focused on the shape of red blood cells recognition, most of them did not discuss the cell characteristics, such as the major axis of a cell, minor axis of a cell, overlap rate of cell recognition and computation. Therefore, the main purpose of this research is through red blood cells characteristics recognition to try to replace the traditional animal model approach. This study proposed a new algorithm coded as software to proceed red blood cells characteristics image recognition. After validation, the proposed algorithm successfully recognized the major axis of a cell and minor axis of a cell. The percentage of Hemagglutination rate was successfully calculated. The study would be applied into distribution industries, which transport the live fishes, saving money because due to reducing the fish death rate. In future studies, if some of the assumptions, colored methods or chemical reactions are relaxed or revised, it may recognize different biological photos.**

Keywords- *Red Blood Cells Characteristics, Image Recognition, Biological Signal Processing, Multimedia Application, Hemagglutination Algorithm.*

I. INTRODUCTION

Blood cells characteristics recognition is an important issue for food nutrition. Food scientists want to know the detailed information of fish red blood cells, such as the major axis of a cell, minor axis of a cell, overlap rate of a cell. It would determine the scale of agglutination of red blood cells. That means the more fatigued a fish, the more agglutination of red blood cells are. In the animal model, we determine if a medicine significantly outperforms control groups via death rate of fishes within certain days. In this study, red cells characteristics levels approach was proposed. It means that the fishes would die at a lower rate than animal model due to red blood cells image recognition replacing death rate of fishes. Previous researches focused on theshape of red blood cells recognition, most of them did not discuss the cell characteristics, such as the major axis of a cell, minor axis of a cell, overlap (Hemagglutination) rate of cell recognition and computation. Therefore, the main purpose of this research is through red blood cells characteristics recognition to try to replace the traditional animal model approach. If it could be entirely successful, it would be applied into distribution industries, which transport live fishes, saving money because due to reducing the fish death rate.

II. LITERATURE REVIEW

Image recognition is that of determining whether or not the image data contains some specific object, feature or activity. There were several studies focused on red blood cells image recognition. Wu *et al*. [5] presented a blood perfusion model of human faces based on thermodynamics and thermal physiology. Their target was to convert the facial temperature data which are liable to ambient temperature into consistent blood perfusion data in order to improve the performance of infrared (IR) face recognition. In their experiments it has been demonstrated that the blood perfusion data are less sensitive to ambient temperature if the human bodies are in a steady state, and the real data testing demonstrated that the performance by means of blood perfusion data is significantly superior to that via temperature data in terms of recognition rate. In their research, recognition of blood would be of benefit to real world application. Adjouadi *et al*. [2] proposed a new algorithm to optimize the pattern recognition of different white blood cell types in flow cytometry. The behavior of parametric data clusters in a multidimensional space was analyzed using the learning system known as Support Vector Machines (SVM). Beckman-Coulter Corporation supplied flow cytometry data of numerous patients to be used as training and testing sets for the algorithm. Subsequently, the characteristics of the cells provided in these sets were used to train a SVM based classifier. The objective in developing this algorithm was to identify the category of a given blood sample and provide information to medical doctors in the form of diagnostic references for a specific disease state, lymphocytic leukemia. With the application of the hypothesis space, the learning bias and the learning algorithm, the SVM classifier was successfully trained to evaluate misclassification ratios in flow cytometry data in an effort to recognize abnormal blood cell patterns. In their research, they focused on shape recognition of a

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blood cell; they did not discuss the length and width of a blood cell. This study furthermore discussed the detail of blood cell characteristics.

Xu *et al*. [7] presented that fingerprint recognition, face recognition, voice recognition and other biometric technology are experiencing rapid development. Their paper addressed a new biometric technology- the identification and recognition based on point of blood vessel skeleton for ocular fundus. The image for green gray scale of ocular fundus was utilized. The cross point of skeleton shape of blood vessel for ocular fundus using contrast-limited adaptive histogram equalization was extracted at first. After filtering treatment and extracting shape, shape curve of blood vessels was obtained. The cross point of shape for curve matching was later carried out by means of cross point matching. The recognition based on shape for blood vessel of ocular fundus had been demonstrated in their paper to possess high identification and recognition rate and a low rejection recognition rate. Their research focused on blood vessel skeleton.

Osowski *et al*. [4] presented the application of a genetic algorithm (GA) and a support vector machine (SVM) to the recognition of blood cells based on the image of the bone marrow aspirate. The main task of the GA was the selection of the features used by the SVM in the final recognition and classification of cells. The automatic recognition system had been developed, and the results of its numerical verification were presented and discussed. They showed that the application of the GA was a powerful tool for the selection of the diagnostic features, leading to a significant improvement of the accuracy of the whole system. In their research, heuristics would be applied into blood cells recognition and classification; however, they did not discuss the length and width of blood cell or more detail information of blood cells inside. Wang *et al*. [1] published that water-soluble CdTe/CdS quantum dots (QDs) were synthesized in aqueous solution with captosuccinic acid as a stabilizer. The absorption and fluorescence spectra showed that the as-prepared QDs had good optical properties. It was observed that the quantum yield (QY) of QDs was greatly increased after a heating-cooling cycle. Then, the QDs were used to prepare fluorescent probes. The experiment results showed that the transferrin (Tf) could conjugate to QDs effectively and the HepG2 cells could be recognized successfully. The study was of great significance for the preparation of high-quality QDs and their applications in life science. In their research, a cell would be recognized. However, this study focused on red blood cell recognition.

Rezatofighi *et al*. [3] published that an automatic system which was capable of recognizing white blood cells can assist hematologists in the diagnosis of many diseases. In their paper, they proposed a new system based on image processing techniques in order to recognize five types of white blood cells in the peripheral blood. To segment nucleus and cytoplasm, a Gram-Schmidt orthogonalization method and a snake algorithm were applied, respectively. Moreover, three kinds of features were extracted from the segmented areas and two groups of textural features extracted by Local Binary Pattern (LBP) and co-occurrence matrix were evaluated. Best features were selected using a Sequential Forward Selection (SFS) algorithm and performances of two classifiers, ANN and SVM, were compared. The results demonstrated that the methods were accurate and fast enough to execute in hematological laboratories. In their research, recognition techniques would be applied into recognizing white blood cells.

Although numerous literatures were related to biological image recognition, there is only a limited amount of literature available on red blood cells recognition.

III. RESEARCH METHOD

This section contains three segments to discuss, 1.The system development process and structure; 2.The special features of the system; 3.The Hemagglutination algorithm.

A. The System Development Process and Structure

The system development process takes the prototyping angle to carry on. The prototyping is the target of the development to adopt the right strategy and correction to fit the system goal. The software is designed by Microsoft Visual Basic 6 and the storage approach is CSV format [6].

B. The special features of the system

The special feature of the system is to demonstrate the recognition approach (See Fig.1). First, a red blood cell photo was digitalized by Matlab 2009 software. The photo would be transfomed into RGB (three basic elementary color) array. In order to reducing complexities, the photo would be re- transformed into gray mode following RGB step. After that, the Hemagglutination algorithm (HA) was compiler as executive file and coded by Visual Basic 5. The next section would describe the detail steps of Hemagglutination algorithm. Finally, the system will output the statistical data of the major axis of red cells, minor axis of red cells, overlap rate of cells.

The recognition system contributed that it used a red blood photo to replace death rate of fish animal model. Furthermore, it also contributed physical live fisher logistics company cost down due to extending the fish live in transportation process.

C .The Hemagglutination Algorithm

Hemagglutination is a biological term. When fish is scared, red blood cells of a fish will proceed hemagglutination. The proposed algorithm, Hemagglutination Algorithm (HA), would determine how agglutination was of red blood cells by biological photos.

The steps for the Hemagglutination Algorithm (HA) were (1) determination of location of cell nuclei (2) determination of location of cell membranes through calculating from nuclei (3) calculation of average length of major and minor axis of red blood cells (4) determination of contact of adjacent red blood cells (5) statistical analysis of all red blood cells and got the percentage of Hemagglutination rate. The descriptions of steps (see figure 2) were as follows:

Step 1: Determination of location of cell nuclei

In blood samples, a cell nucleus usually contains a clearly black color zone. The software should try to identify these special zones.

Step 2: Determination of location of cell membranes through calculating from nuclei

The searching procedure starts from a cell nucleus, and then passes through white zones until the adjacent grey zone. These grey zones are red blood cell membranes.

Step 3: Calculation of average length of major and minor axis of red blood cells

There are eight searching directions, with regard to 45 degrees, separately. The program would calculate the average of half length of major and minor axis of red blood cells and ignore the over long length data (because it may miss coloring).

Step 4: Determination of contact of adjacent red blood cells

The program would predict the contact zones of membrane of adjacent red blood cells by calculating the distance between two cell nuclei minus the average of half length of red blood cells major and minor axis within two adjacent cells.

Step 5: Statistical analysis of all red blood cells and obtain the percentage of Hemagglutination rate

To calculate the percentage of Hemagglutination rate.

IV. COMPUTATION RESULTS AND DISCUSSION

The experiments proceeded on the basis of the proposed algorithms. We used a Pentium IV (Celeron CPU 2.40GHz) computer for the computations. In figure 3, it showed that the photo had been redrew and replaced by symbols through gray processing using threshold selection. It meant that the information system would recognize a cell nucleus and membrane. In table 1, the recognition system output the following important data: major axis of cell, minor axis of cell and overlap rate of cell. The biologist can compare the blood samples to identify the difference between different treatments of biological experiments.

We found proposed algorithms would calculate agglutination of red blood cells. The more fatigued a fish, the more agglutination of red blood cells there are.

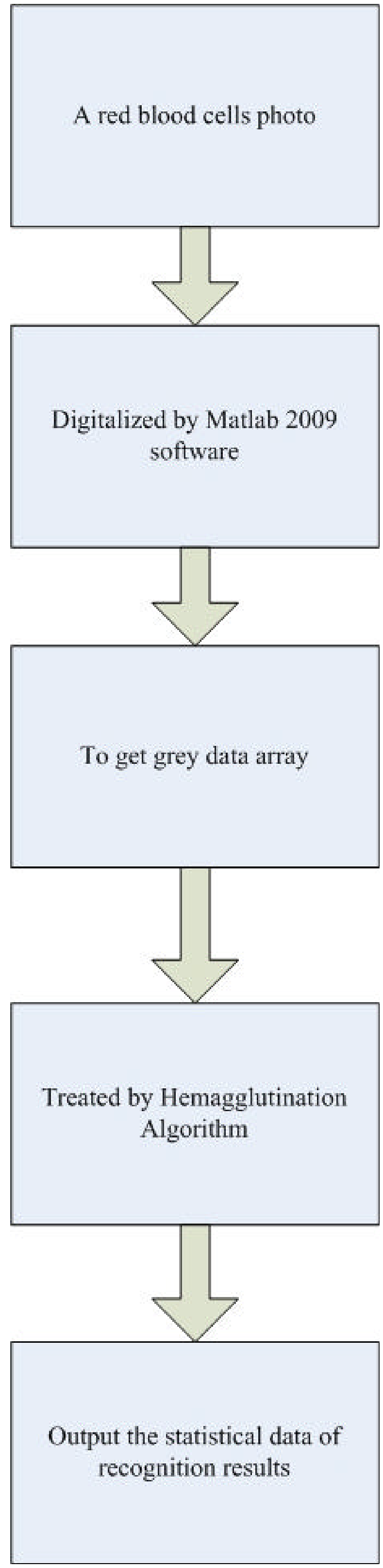

Figure 1. Hemagglutination Recognition System

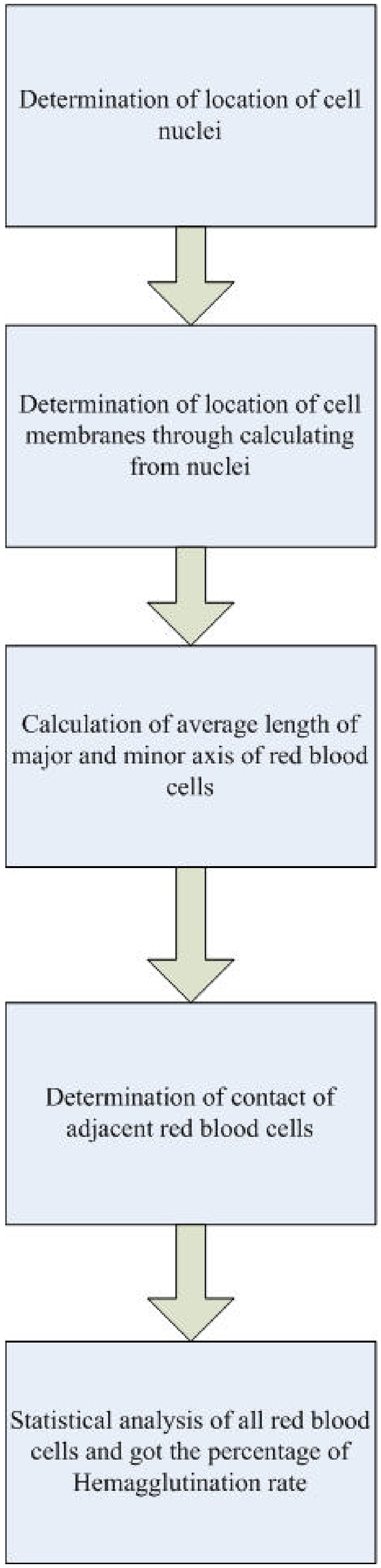

Figure 2. The Hemagglutination Algorithm

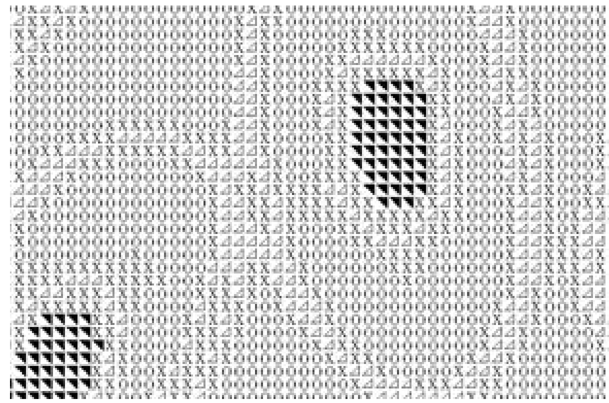

Figure 3. Cell Nucleus and Membrane Recognition

Table I. Example of Red Blood Cells Characteristics Recognition

Output	Data (Unit)
Number of Red Blood Cells	33
Average half length of major axis of cell	63.27 ± 23.43
Average half length of minor axis of cell	36.29614 ± 18.88
Ratio of major vs. minor axis	2.20 ± 1.75
Percentage of Hemagglutination rate	82.76 %

V. CONCLUDING REMARK

Blood cells characteristics recognition is an important issue for food nutrition. Food scientists want to know the detail information of fish red blood cells, such as the major axis of a cell, minor axis of a cell, overlap rate of a cell. It would determine the scale of agglutination of red blood cells. The more fatigued a fish, the more agglutination of red blood cells there are. The main purpose of this research is through red blood cells characteristics recognition to try to replace the traditional animal model approach. If it could be entirely successful, it would be applied into distribution industries, which transport the live fishes, saving money due to reducing the fish death rate. After validation, the proposed algorithm successful recognized the major axis of a cell, minor axis of a cell and overlap rate of a cell.

In this study, we leave many other biological minor characteristics and do not discuss. It may result in different conclusions if some of the assumptions, colored methods or chemical reactions are relaxed or revised.

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