Detection and classification of the Acute Myeloid Leukemia cells in the images of white blood cells

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In recent decades, image processing has been applied to many applications of life. In particular, imaging applications are emerging as a new opportunity for innovation at the meeting point between medicine and computer science. By the help of image processing, we can extract many useful information from medical images in order to assist and improve patient diagnosis especially in the cancer area.

Leukemia is a cancer of white blood cells, where the disease basically develops in the bone marrow, which is the spongy tissue that fills the inside region of the bones. There are four major different forms or types of leukemia, which develop in cancer patients according to the growth speed and the improper overproduction of leukemia cells: acute lymphocytic leukemia (ALL), acute myeloid leukemia (AML), chronic lymphocytic leukemia (CLL), chronic myeloid leukemia (CML).

This study will focus on AML type. AML is a general form of acute leukaemia that is increasingly common with progressing age but may occur in all age groups. Acute myeloid leukemia is the second frequent type of leukemia diagnosed in children. Most commonly, acute leukaemia patients are referred to specialist units for evaluation.

It is important to accurately determine the subtype of leukaemia, since treatment may differ. In case of wrong diagnosis, patients face complications and may die. The early recognition of blast cells in the bone marrow of patients suffering from AML, during the developmental stage of the illness, is extremely important for appropriate treatment. Currently, the whole process was manual in nature and thus was time consuming and exhausting. Nowadays, there are several research groups focusing on the development of image processing application for medical images that collaborates with the clinicians. With a blood cell image of leukemia patient, the process of detection and classification depends on human look and it takes up to a few days. Haematologists are very difficult to identify the correct subtypes, given the morphological similarities they share.

The goals of this study is to investigate the development of an automate method for the detection and classification leukemia cells from the blood cells images that are captured as microscope images. The result of this study assist the heamatologist's diagnosis of AML cases to provide the correct form fo treatment. Besides, it also helps the diagnostic process to reduce in terms of its time span from a few days to a matter of a few hours and the cost of all processes. Moreover, this method limited the impact of human beings during the diagnostic process.

To achieve the goal of this study, a system was presented. There are two main stages in this system. The first stage is detection. In this stage, it located all the AML cells that appearing in the input images. Different to the existing works, they only focus on detecting the nuclei of AML cells, this study detect and locate both the nuclei and the cytoplasm of AML cells. This work is very difficult because the characteristics between the cytoplasm and the background are similar, so the proposed method will solve this problem. The second step is classification. This stage classifies the AML cells into four subtypes. After the detection stage, the AML cells were segmented. The author extracted the features from the nuclei and the cytoplasm of AML cells and distribute them into a feature vector. This vector used to training for the learning model and testing the accuracy of the classification.

In detection stage, the author proposed a method to detect the nuclei and cytoplasm of AML cells based on the change of gradient magnitude to filter the region of cytoplasm. Although it can not solve all the cases of the problems, but it worked and achieve the encouraging results with almost cases of dataset. In classification stage, the color features, histogram features and texture features were extracted from the AML cells. The SVM learning model was applied for training and validating the dataset.

We tested the system with 301 images which total 643 AML cells. The performance of proposed method is shown in table II. We properly individuated 533 of 643 AML cells, for an average accuracy of 92.4%. The proposed method was demonstrated to improve the detection performance when compared to another method (increase 26.9% the accuracy). Experimental results confirmed that the proposed method in detection stage can efficiently segment the nuclei and cytoplasm of AML cells. The accuracy of M3 classification was achieved 97.2%. The average for four subtypes was 93.5%. This is an acceptable results for the diagnosis white blood cells.

In summary, this study proposed an automated method for the detection and classification of AML cells. A new idea was presented in the proposed method to detect the nuclei and cytoplasm. In the classification stage, the AML cells were classified into four subtypes. The detection and classification methods were tested with the real dataset and achieved the good results.