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主　論　文　の　要　旨

論文題目　**Microfluidic Devices for Capturing, Imaging and Counting White Blood Cells**
(ヒト白血球の捕捉，検出，計数のための マイクロ流体デバイス)

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論　文　内　容　の　要　旨

The most common blood examine in clinical medicine is white blood cells (WBCs) count. Various diseases cause changes in the blood composition or cell populations, and therefore, the analysis of blood is essential in clinical diagnosis. Furthermore, WBCs provides information about health status, such as WBCs count is changing due to diseases commenced. The WBC subpopulation cells counting such as lymphocytes, T and B cells are very important to determine the health condition, specifically the immune system. Current trends of cell counting instruments are moving forward to have featured such as portability including miniature system, cost-effectively including sample processing, system management and maintenance. Moreover, the result produces are rapid, reduces delays of treatment, and provides better monitoring system in the limited resources area. Conventional system used for this cell separation and counting task are accomplished using flow cytometry. The main advantages of flow cytometry are able to analyse simultaneous parameters and provides high throughput. However, despite all the advantages, the instruments are costly (operation and maintenance), sophisticated system, often bulky in size and required a highly trained specialist to operate them. Hence, microfluidic provides an alternative technique of cell separation and counting. Moreover, this technology offers cost reduction, device portability, very small sample volume, disposability device and suitable for point-of-care applications.

We proposed a simple microfluidic device for cell separation and counting applications. The device comprises of microfilters that serve as the filtration mechanism based on sizes and deformability. Conventional microfilters mechanism suffers from device clogging. Thus, a simple solution to eliminate this problem by utilizing a gradual filtration concept, and microfilters escape route. The microfilters gap size gradually decreases from 15 μm to 3 μm to facilitate the deformability-based separation. Leukocytes have various sizes; hence, they can be separated by microfilters directly from whole blood samples without any cell clogging, and they do not require samples pre-processing such as centrifugation or red blood cell lysis which is tedious and costly. As a result, we succeeded to achieve that our technique able to separate WBCs from whole blood with a high efficacy of 99%. Moreover, the repeatability test of the proposed device shows low coefficient of variations with only 2.77%. Furthermore, the developed imaging system and a simple cell counting algorithm gave a statistically significant correlation and agreement with standard laboratory flow cytometer method.

In conclusion, the proposed method allows a very low sample processing, provides a short time of sample pre-treatment (less than 20 minutes), simple technique in reducing device clogging caused by the cells, and good agreement with a conventional instrument. The use of microfluidic technique for cell counting and deformability study seems very promising.