Project Proposal

Title: Automatic cell counter and characterization with Matlab/OpenCV
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Project description:

Background
The goal of this project is to develop an image processing program that can be used to automate cell counting and characterization with a hemocytometer for laboratory uses. Currently, cell counting is usually done manually. Typically, user would pipette cells in suspension into a chamber (Fig. 1) with grids of specific sizes. The user would have to count cells in each of the bright square grids as shown in Fig. 1 and average the cell count in these grids to get an estimate of the total cell count. Example of cells in the sample is shown in Fig. 2.

Various studies have reported the development of image processing programs to automate cell counting and identify cell viability as well as morphology\textsuperscript{1-4}. Automating these quantifications with image processing may speed up the process and has been shown to reduce operator-dependent biases\textsuperscript{1}. In addition, it provides quantitative information about cell morphology that may be used for monitoring and modeling cell behavior that cannot be obtained by qualitative observation.

Fig. 1. Using a hemocytometer to count cells.
Proposed project
The proposed image processing program will accomplish the following:
1. Count the number of cells automatically and provide the average number of live (transparent) and dead (blue) cells
2. Average diameter of the cells and possibly other morphological information (e.g. cell shape, size, etc.) that can be valuable in better understanding cell behavior.

The image processing code will work as follow:
1. User will take an image of the entire field of the hemocytometer (similar to Fig. 1).
2. The image processing code will be able to identify and locate the 5 square grids.
3. The image processing code will identify the cells (through thresholding, edge detection, dilation/erosion, etc.) and distinguish whether each cell are alive or dead (blue hue).
4. The program will output the number of cells in each square grid, outline the edges/provide a threshold image showing the location of the cells, and give information on the number of live/dead cells in each grid, the average number of cells in the 5 grids, and also calculate the average diameter of the cells.

Advantage of proposal platform
Although automated cell counting programs have been developed, users have to import images to these programs on a computer. Often these programs serve as a post-processing tool and do not provide real-time quantification that can replace manual cell counting carried out in the laboratory. The goal of this project is to develop a cell counting and characterization code using Matlab/OpenCV that is compatible with android mobile device and may be implemented in phone apps to provide real time quantification.
Potential challenges
Since the image will be taken with a phone camera through an eyepiece, the image will probably have uneven lighting. In addition, the hemocytometer will probably appear in the image slightly tilted, and the image processing code probably needs to be able to identify the rotation angle and rotate the image before identifying the 5 grids and counting the number of cells in each grid.

References