Template for thesis project proposals

Project Title	Master Thesis Project
Author(s)	Amir Etbaeitabari, Mekuria Eyayu
Keywords	*Give 4-5 keywords*

== Summary ==

Counting white blood cells in microscopic images is a tool for physicians to diagnose the human body health condition. The aim of this project has been twofold. Firstly, we made an application for synthesizing data with known ground truth objects. These objects are elliptical in appearance of five different classes within in a volume by considering the depth of focus (DOF) 15 photos are taken (captured) from the volume at different depth (see examples below).
Secondly, we provided an algorithm that exploits the multiscale nature of the problem in order to improve recognition. The variation of gray value for each pixel in different depth is used as feature source for classifier. The classifier divides the pixels in three different groups, background pixels, pixels in single cells and pixels in overlapping parts.
For counting the total number of cells, centroids of overlapping areas are used for bisecting the overlapping ones.
The final result contains different models varying noise density and resolution, which contains accuracy of overlapping positions and area of overlapping found correctly in the image. In non-noisy environment the performance for accuracy of overlapping positions is x1 % and for area of overlapping places is y1 % for density of 150 cells and is x2 % and for area of overlapping places is y2 % for density of 200 cells.

== Introduction ==

Counting white blood cells from microscopic images is a tool for physicians to diagnose human body health condition. Providing a large clinical data set is necessary for calculating performance measurements of different segmentation algorithms. In spite of hard accessing to datasets, experts are needed to use visual analysis to obtain the Golden Ground Truth. In addition, there are negative factors like noise, poor image quality and variant illumination which make it harder to extract the ground truth.

In our project, we have introduced an algorithm for making different models of volumes containing cells with some flexible parameters .The requested numbers of elliptical cells of different classes are generated randomly inside a defined volume. The analyzers could have access to the ground truth for evaluation of the performance. Furthermore, the effect of variation in factors like noise, resolution and illumination variance can be studied independently or in combination in our models. The synthesizing algorithm provides an opportunity to analyzers to experience and consider different conditions and environment properties such as different cell density, noise density and resolution by varying different factors in the algorithm for generating different cell models. Requested numbers of photos by user are captured by a virtual fixed camera by changing its focal length while focusing at different equidistant depths in a volume. Depth of focus effect for cells in different depths is considered.

Identifying overlapping areas (positions) and counting the total number of cells in different environments is our main concerns in this project. For an environment with predefined constant brightness, a method using the gray value average of all depths is applied for finding the overlap places due to its simplicity, less computational time and efficient results. The average of gray values from the sequence of photos besides defining a threshold is used for this approach. Furthermore, different features such as the magnitude of discrete Fourier transform and 1D derivation of the sequence of each pixel gray values in the depths are extracted . After preprocessing the data, it is given as input to linear and neural network classifiers to make a robust algorithm for classification of each pixel in three different groups, background pixels, pixels in single cells and pixels in overlapping parts, by considering different noise densities and photos with different resolutions. The results are compared with some pervious works.

== Background==
Developing a robust algorithm for Identifying and separating overlapping particles in a microscopic images is one of the main concerns and research work for computer scientists. The current overlap separating approaches are based on prior particle shape and gray value intensity. Like watershed method [10,11], and mathematical morphology method [3,8,9] faces an over segmentation problems and expensive in computational time. [xxx]

According to [Gloria Diaz,Fabio Gonzalez and Eduardo Romer] they proposed a static