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Automat. Comput. Appl. Math.
Volume 16 (2007), Number 3

## Computer Science



## Workshop on Grid Computing

# Computer Aided Diagnosis Tool for Cytological Slides

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## Abstract

*Cervical cancer is one of the leading causes of women's' death, but if discovered early, the chances of a cure are as high as 90 percent. To reduce the risk of high stage cervical cancer and its incidence and mortality, women are advised to be screened with Pap test at least every two to three years. Because of high number of cytological slides needed to be processed in a cytological laboratory, a computer aided diagnosis tool is very helpful. This paper deals with an automatic system and method for detecting and classifying diagnostic cells. The main goal in this case is the recognition of Cervical Intraepithelial Neoplasia (CIN) grade. First a robust segmentation method is used. Then set of relevant features characterizing atypical cells are extracted. Finally a method for the CIN grade prediction is proposed based on the performance analysis of different statistical classifiers.*

## 1. Introduction

Mass screening programs of the population to identify seemingly healthy individuals has been a growing trend for over 30 years, to prevent the incidence of some diseases which represent a substantial public health burden. Cervical Intraepithelial Neoplasia (cervical cancer, called CIN) is one of the most common form of cancer among women worldwide. As all the tumors, cervical intraepithelial neoplasia changes continuously in time. Over longer periods of time, its physical and functional characteristics change significantly. If it is discovered early, in the first stage of disease, the chances of a cure are as high as 90 percent. CIN has three grades of evolution: 1 (mild), 2 (moderate) and 3 (severe) and is characterized by some distinct features [1]: disproportionate nuclear enlargement, which leads to high nuclear-to-cytoplasm ratio, hyperchromasia, irregularity in form and outline of the nuclei, irregular chromatin distribution, presence of keratinization, abnormalities in the number, size and form of the nucleoli, multi-nucleation.

The traditional screening test is called Pap smear and consists in the examination of cells collected from the uterine cervix in a cytology laboratory under the microscope. Even the best laboratories can miss from 10 up to 30% cancerous cases (false negatives), or made some mistakes (false positives) due to the following reasons:

- Huge number of normal slides being analyzed, each containing a huge number of cells;
- Large number of views that must be explored under microscope for each slide
- Short time allocated to each slide (10-15 minutes).

In this case the "cost" of false negatives is much important then false positive rates.

The impossibility for the human eye to detect all cases of cancer, lead to the need of creating some automated methods of cancer detection. The most significant researches done so far are: the Papnet (a system based on neural networks) [2], a fractal analysis-based approach [3], an optics-based approach [4], visual inspection detection [5], direct visual inspection or self-adaptive methods based on the existence of localized group of discriminatory elements [6] or image-processing based approaches applied on single cell images [7],[8]. Unfortunately, most of these approaches are not completely satisfactory and none detects perfectly the tumor, because of the complex CIN cell-patterns involved, with arbitrary orientation, location, features and scale.

The performance of a CIN grade recognition system depends on many factors:

a). *Slide preparation methods*: Having perfectly prepared smear slides is an expensive process because it implies technological resources like ThinPrep, AutoCytePrep, Sure-Path System [9] etc. The slides prepared with traditional techniques present some