

Chapter 12

Computational Intelligence– Based Cell Nuclei Segmentation from Pap Smear Images

Savitha Balakrishnan

Avinashilingam Institute for Home Science and Higher Education for Women University, India

Subashini Parthasarathy

Avinashilingam Institute for Home Science and Higher Education for Women University, India

Krishnaveni Marimuthu

Avinashilingam Institute for Home Science and Higher Education for Women University, India

ABSTRACT

Automated Segmentation of cell nuclei in Pap smear images plays an important role in the cervical cancer cell analysis systems to make a correct diagnosis decision. The aim of this chapter is to detail about the variety of computational intelligence and image processing approaches developed and used for the nuclei segmentation. In addition, the threshold based segmentation problem is treated as an optimization problem with an objective of preserving both the size and volume of the cell nuclei and also to segment the nuclei region from the original microscopic Pap smear image with the help of Particle Swarm Optimization (PSO) and Ant Colony Optimization techniques (ACO). Experimental results are shown, compared in quantitative and qualitative manner as well as the main advantages and limitations of each algorithm are explained.

INTRODUCTION

Cervical cancer (*Cancer of Uterine cervix*) is caused by the virus called *Human Papilloma Virus*. It is a preventable type of cancer which is characterized by a long lead time. The precancerous cervical cells gradually progress through recognizable stages before developing into invasive cancer cell. Several risk factors like *smoking, HPV infection, multi-sex partner, oral contraceptives, age group 35-50 years, low socio economic status and early marriage* such things increase the chances of getting cervical cancer.

DOI: 10.4018/978-1-5225-0983-7.ch012

Women without any of the above risk factors rarely develop cervical cancer. Sexually transmitted *HPV infection* is believed to be responsible for *90 to 95 percent* of all cervical cancers. Figure 1 shows the causative factor for Cervical Cancer.

Cervical cancer begins with the development of pre-cancerous, benign lesions in the cervix area. According to WHO classification, the first stage of growth is mild dysplasia, which can then progress to becoming moderate dysplasia, severe dysplasia, and then carcinoma in situ (CIS) or invasive cervical cancer (Ambika Satija). Mild dysplasia usually regresses on its own without treatment, and doesn't progress to moderate or severe dysplasia. A small percentage of women with mild dysplasia, however, will progress to more severe forms, although this can take as long as 10 years. Women with moderate to severe dysplasia are at high risk of developing invasive cancer, although the progression from severe pre-cancerous lesions to cancer may take several years as well (Alliance for Cervical Cancer Prevention, Cancer Research UK).

The term pap-smear (*Pap-smear test*) refers to the samples of human cells stained by the so-called Papanicolaou method (B. Savitha & P. Subashini, 2013). In the beginning, using a small brush, a cotton stick or wooden stick, cervical specimen is taken from the uterine cervix and transferred onto a thin, rectangular glass plate (slide). The specimen (smear) is stained using the Papanicolaou method. This makes it possible to see characteristics of cells more clearly in a microscope. Figure 2 shows the Pap smear test procedure to acquire the digital Pap smear image.

With the increasing use of medical imaging for diagnosis and treatment planning, it has become almost necessary to use computers to assist pathologist in clinical diagnosis as well as in treatment planning. Reliable techniques are required for the delineation of anatomical structures and other regions of interest (ROI). The goals of computer-aided diagnosis are (Neeraj Sharma & Lalit M Aggarwal, 2010)

Figure 1. Causative factor

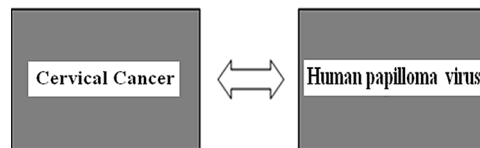
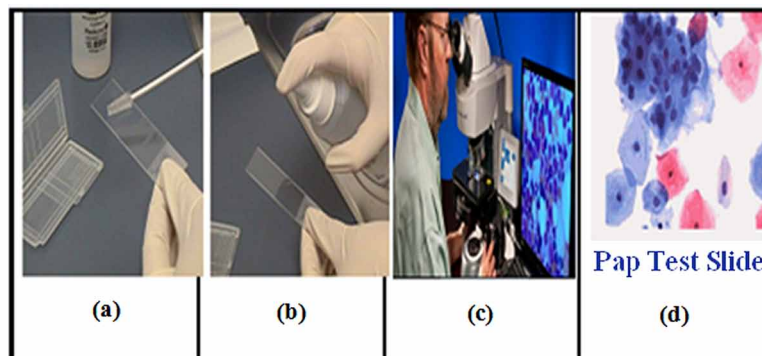


Figure 2. Pap smear procedure



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