Identification and differentiation of HPV subtypes through microscopic image analysis

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Human Papillomavirus (HPV) is considered as major factor for cervical cancer (CxCa) incidence [1]. More than 100 different HPV types have been certified and have been categorized into high-risk and low-risk groups. High-risk HPV types are associated with more than 90% of CxCa, and are considered as the main cause for Cervical Intraepithelial Neoplasia [2]. The traditional examination for early scanning is Pap smear cytology, while HPV DNA test by Polymerase chain reaction (PCR) has been increasingly recommended as the method of choice for HPV type identification. HPV DNA examination by PCR is of high complexity and cost, especially in low income population and countries, where the incidence of CxCa is very high [3]. The aim of the study is to develop and evaluate an image analysis and classification system to detect and identify the HPV high-risk types [4] prior to complex HPV DNA analysis. The clinical material
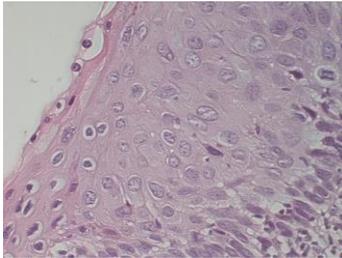

Figure 1: HPV image

comprised fifty five cases of verified HPV subtypes (through PCR analysis) collected from Department of Pathology of the University Hospital of Patras, Greece. Twenty six cases were of high risk and twenty nine cases of low risk HPV subtypes. Images were digitised from original samples using a Leica DM2500 light microscope coupled with a Leica DFC420C digital camera. Seventy seven image descriptors (textural, morphological and architectural) were extracted from the digitized images.

A Graphics Processor Unit and parallel programming technologies were used to accelerate system design processes, thus, rendering plausible optimal system design. Of the descriptors examines, ten were found to sustain statistical significant differences ($p<0.001$) between high and low risk HPV cases. System accuracy in discriminating between high/low-risk HPV subtypes was over 90%. Differences in image texture and morphology, inflicted by decease progresion, are analyzed and the best combination of descriptors, reflecting image properties, may provide important additional information to the expert physician, regarding disease differentiation.

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