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Cervical Cancer Detection System Analysis by Segmentation Methods

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ABSTRACT

Cancer has been materialized to be paramount health issues of humanity. One of the prevalent types of cancer is cervical cancer and The Papanicolaou (Pap) test or Pap smear is the elementary test for cervical screening and it holds the microscopic examination of cervical cells collected from the cervix. As manual interpretation is laborious, unobjective, time-consuming process with extensive deviations in diagnosis among experts. Manual analysis comprises conventional cytology of biopsy sample or Pap smear. The accuracy of the Pap test is influenced by the two dominant factors: sampling error where diagnostic cell does not fall onto the slide, the other being interpretation error caused by inexperienced lab technicians.

Keywords : Papanicolaou (Pap), PET, MAP.

I. INTRODUCTION

Today, cancer has been materialized to be paramount health issues of humanity. In this dissertation, Olympus ch20i microscope is positioned to capture the single cell pap smear image with a 100x magnification at a resolution of 75mm were used, which is set in such a way that adequate information can be preserved for impressive classification. Pap Smear images taken by the microscope encompass three elements: background, cytoplasm and nucleus. Nucleus renders information needed for diagnosis by which samples are probed for finding abnormalities and observing the spread level of the abnormalities.

The empirical survey on cervical cancer detection system by using different kinds of segmentation methods is presented here. As segmentation is the predominant process for easy identification of malignant cells in the histological images, every framework would then adopt segmentation as foremost process for implementing cancer detection model. This section reports the resulting of a systematic study to influence the segmentation process system that has led to the accomplishment of cervical cancer detection framework.

II. METHODS AND MATERIALS

This survey also identifies the gap and inconsistencies in the feature extraction techniques and classification of cervical cancer diagnosis.

Zhi et al, (2017) have evaluated three segmentation algorithms for overlapping cervical cells in cervical cytology images. As the variation in size, shape and occupying of debris, poor contrast, and high degree of cellular overlap affects the computer aided detection system, three novel segmentation methods were proposed. Of these, first is based on segmentation of sub cellular compartments combining super pixel representation with voronoi diagrams which implements the task of segmentation in four stages that include preprocessing (applying bilateral filter), identification of cellular clumps using super pixel definition and finally segmenting cell clumps into nuclei. This system focused on only overlapped cells.

Youyi et al, (2017) have proposed a learning based method with robust shape where in multi-scale deep convolution networks are incorporated to learn the different cell external features. Due to the reason of cell overlapping, significant information has been utilized to assist segmentation of the weak cell boundary. This approach has three major tasks: cell

module segmentation, multiple cells tagging and cell border refinement. Performance was analyzed by gathering 5650 background, 8590 cytoplasm, and 8560 nucleus pixels from eight images in the SZU dataset. Even though, this paper provided much emphasis on splitting of overlapping cells, it fails to address folded cells which is challenging task than the separation of overlapped cells.

Savas et al. (2016) reviewed existing assays and platforms used in HPV diagnosis which will mount recent moves in nanotechnology and micro fluids that has the capability in enabling novel approaches for HPV diagnosis. It has been developed for bio sensing platform intended for ultrasensitive detection of HPV which comprises detection area by which biomarker is sensed using optical, electrical and magnetic mass bio-sensing platform. Here, following types of technologies have been employed for the detection of HPV virus.

- Fluorescence based detection
- Nano-particle based optical detection
- Mass-Based Detection Technologies
- Acoustic Detection Technologies
- Magnetic Detection Technologies

Wei et al. (2015) have implemented an automatic segmentation method for the cervical tumors by combining the gradient field information of both the filtered PET image and the level set function (LSF) by creating a new evolution equation. In addition, a new hyper-image to identify the rough tumor region using fuzzy C-means algorithm based on the specificity of the tissue by both Positron emission tomography (PET) and CT in order to offer initial zero level set by which segmentation process would become fully automatic. To analyze the performance, sample are collected from twenty-seven cervical cancer patients at various stages and dissimilarity coefficients as well as distance were used as benchmark for assessing the accuracy of the method.

Chao L et al. (2012) have addressed the problem of non-rigid registration and tumor detection in cervical magnetic resonance (MR) data using a unified Bayesian framework where in tumor probability map is built for discovering the boundary of a significant organ. This framework is setting the foundation using maximum a Posteriori (MAP) by which deformable segmentation, non-rigid registration and tumor detection can be done in parallel. Also, intensity matching is performed as a mixture of two distributions from which image gray-level variations for two pixel classes: tumor and normal tissue are stated statistically. This system can able to handle issues caused by the regression and presence of tumor when all the previous methods fail to do so.

Amir et al.(2010) have offered a procedure for extraction and segmentation of class specific region using class specific boundaries in uterine cervix images. Markov random field has also been modelled to correctly identify whether the particular region is lesion tissue or not. The local pairwise factors which are based on supervised learning of a visual word distribution applied on the arcs of the watershed map define whether the certain arc is the element of object boundary. Loopy belief propagation on the watershed arc-level MRF is incorporated to find the last lesion region segmentation and boundary details is utilized with no added-region-based input.

Yeshwanth et al (2009) have developed automated diagnostic system for cervical intraepithelial neoplasia (CIN) and to segment macro regions, algorithms by mathematical morphology, and clustering using Gaussian mixture modeling (GMM) in a joint color and geometric feature space has been introduced. Vascular abnormalities in CIN, such as mosaicism and punctations are formed as a texture classification problem, and the issues are solved by the neighborhood gray-tone dependences and co-occurrence textural statistics features. This system translates digital images of the cervix into a entire diagnostic tool, with less human intervention and it helps to clinicians to identify abnormalities caused by CIN and monitor the affected areas for a biopsy.

Yinhai et al. (2009) have incorporated a computer assisted system for the identification of cervical intraepithelial neoplasia (CIN) by means of ultra-large cervical histological digital slides which comprises two process i.e. separation of squamous epithelium and the identification of CIN. In the segmentation process, multiresolution was introduced to reduce processing time and squamous epithelium layer is primarily segmented at a low resolution followed by higher resolution. Support vector machine has also been employed to do classification process after that

medical rules has been applied to classify into normal, CIN I, CIN II, and CIN III. In addition, inter-observer variability between two pathologists has been taken into account.

Table 2.1 shows the overall merits and demerits of the existing cancer detection systems based on segmentation process.

Table 2.1 Segmentation based Cancer Detection System

Author	Technique	Inference	Pros	Cons
Zhi et al. (2017)	Voronoi diagram, Super pixel definition, segmenting cell clump.	Removing noise by bilateral filter, identification cellular clumps using super pixel definition	Integration of three methods	As it uses standard benchmark data, not verified underground truth dataset.
Youyi et al, (2017)	Multi-scale deep convolution networks incorporated	Learning based method and has three module : cell module segmentation, multiple cells tagging and cell border refinement	Overlapped cells are spitted	Fails to split folded cells
Savas et al. (2016)	Fluorescence based detection, Nano-particle based optical detection, Mass-Based Detection Technologies, Acoustic Detection Technologies, Magnetic Detection Technologies	Nanotechnology and micro fluids in enabling novel approaches for HPV diagnosis	Short assay time, device automation potential for long-distance data transfer.	Sensing technologies still need to go through vigorous clinical validation
Wei et al. (2015)	Gradient field information of both the filtered PET image and the level set function (LSF)	Detecting cervical rough tumor region by Fuzzy-C-means algorithm	Work well for segmenting rectum cancer	Automatic definition of the initial contour using FCM may not be applicable
Chao L et al. (2012)	Bayesian framework is presented	A tumor probability map is generated, which estimates each voxel's probability of tumor.	Able to handle the difficult problems by the presence and regression of tumor	Physical tumor regression model and a shape predicting model is not incorporated
Amir et al.(2010)	Random field has also been modeled	Extraction and segmentation of class specific region using class specific boundaries in uterine cervix images	Very fast and user friendly	Features are made rotationally invariant up to a flip factor
Yeshwanth et al (2009)	Mathematical Morphology, and Clustering using Gaussian mixture modeling	Vascular abnormalities in CIN, such as mosaicism and punctuations are identified	Helps to clinicians to identify abnormalities caused by CIN	Preference given to only on segmentation not on classification.
Yinhai et al. (2009)	Multiresolution was introduced	Separation of squamous epithelium and the identification of CIN	The potential of the system in inter-observer variability among pathologists is particularly promising.	Processing of digital slides is very time consuming and currently too slow

III. CONCLUSION

With the help of the above survey we try to implement the digital image segmentation with Gaussian mixture. The segmentation gave good result to find out the exact image result. This system can able to handle issues caused by the regression and presence of tumor when all the previous methods fail to do so.

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