Image Processing Based Colorectal Cancer Detection in Histopathological Images

Anamika Banwari, Amity University, Noida, India
Namita Sengar, Amity University, Noida, India
Malay Kishore Dutta, Amity University, Noida, India

ABSTRACT

The article proposes an image processing-based automatic methodology for early diagnosis of colorectal cancer. In pathology, staining and sectioning of tissues are routinely used as a primary technique to detect cancer. In this methodology, the colorectal gland tissues are segmented by using adaptive threshold method. Also, it includes an analysis of geometrical features of colorectal tissues as well as it does classification of cancerous cells which classify the cancerous and non-cancerous cell efficiently. The classification is based on discriminatory geometrical features which give good result. Unlike existing methods, it quantifies lumen and epithelial cells only in the ROI, which makes this method computationally efficient. Automatic supervised classification is accomplished on the extracted discriminatory features using support vector machine classifier. The proposed methodology segments and classifies the cancerous / non-cancerous region with an accuracy of 93.74%. The proposed method is also computationally fast which makes it suitable for real time applications.

KEYWORDS

Colorectal Cancer, Feature Extraction, Histology, Image Processing, Segmentation, Stained Colorectal Biopsy, Supervised Classification

1. INTRODUCTION

Glands are one of the most important structures of organ systems. The function of gland is to secrete proteins and carbohydrates. There are millions of glands present in the human body and the colonic crypt is one of them. It is an intestinal gland found in epithelial layer. It consists of a single sheet of columnar epithelium. It is finger like structure that extends from the inner surface of the colon into the underlying connective tissues (Rubin et al., 2008; Humphries and Wright, 2008). Colorectal cancer is also known as Bowel cancer. It is a category of cancer that occurs when the tumor is formed in the rectum or the colon (also known as a large intestine system in human body). Large intestine runs a variety of functions like water absorption and break large molecules into nutrients. Also does secretion of mucus to protect the epithelium from a hostile chemical and mechanical environment (Gibson et al., 1996). Colorectal cancer originates from epithelial cells lining of colon. Most of the colorectal cancers are silent tumors. They progress slowly and do not produce symptoms until they
become larger (Watcharapichat, 2012). Colorectal cancer is the third ranked health issue worldwide and most commonly diagnosed cancer. It is also the third most common cancer which causes death in advancing age. According to the American Cancer Society, there were approximately 136,830 patients being diagnosed with colorectal cancer and nearly 50,310 people died from this disease in 2014 (American Cancer Society, 2014-2016). The risk factor for colorectal cancer is clearly increased by a family history of colorectal cancer, chain smoking, low nutrients, and regular eating red meat and fats. The architectural appearance and gland formation of intestinal gland is one of the primary features used in clinical practice to inform prognosis and to plan the treatment of individual patients (Compton, 2000; Bosman et al., 2010; Washington et al., 2009). Traditionally, colorectal cancer was detected through screening examination and histopathology. Screening allows the early detection of bowel cancer that helps in effective treatment. In histopathology, colorectal biopsy specimen is observed under the microscope to detect the existence of cancerous cell. Histopathology follows the tissues assembling on microscope slide then it under goes on hematoxylin and cosin (H&E) staining process to differentiate the nucleus, lumen and other components. Then expert does cancer grading to them depending upon their geometrical changes.

In General, the histopathology has some constraints like time consuming and also based on visual interpretation of pathologist. It has inter/intra distinction in grading (Rathore et al., 2013). The variability of visual interpretation of pathologist poses a challenge to automate this analysis. The glandular structure analysis provides important components to automate the colorectal cancer detection. The important histological components of colorectal tissue can be seen in Figure 1. It shows stained tissue of colorectal biopsy. Middle part of the structure is lumen, which is surrounded by goblet cells. Lumen and goblet cells are bounded by packed structure of epithelial cell nuclei and these all together forms a complete gland unit.

Previous research includes: Hai Shan Wu et.al. Presented a method, in which nuclei has been separated out from other tissue components by using a region growing method (2005). Demir et al. (2010) submitted an object graph method for segmentation, in which the initial seeds for region growing were identified first with help of graph connectivity. Further, region growing is performed up to epithelial boundary. Then, unwanted parts are eliminated at the end. Sirinukunwattana et al. (2015) formulated a segmentation based on Bayesian inference, which treats each glandular structure as a polygon. Tosun et al. (2011) uses graphical models for gland segmentation. Farjam et al. (2007) uses textural features for segmentation. Fu et al. (2014) presented a segmentation method based on polar coordinates. S. Olcay et al. (2008) worked with Follicular Lymphoma gland and used Non-Linear

Figure 1. Stained tissues of colon biopsy (Monaco et al., 2010)
Proposal for Interactive Anonymization of Electronic Medical Records
Carlos Andrés Moque Millán, Alexandra Pomares Quimbaya and Rafael A. Gonzalez (2013). Information Systems and Technologies for Enhancing Health and Social Care (pp. 166-177).
www.igi-global.com/chapter/proposal-interactive-anonymization-electronic-medical/75627?camid=4v1a

REDCap and Rural Health: An Opportunity to Enhance Collaborative Research and Rural Health Care Delivery
www.igi-global.com/article/redcap-rural-health/76343?camid=4v1a