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# Computer-based Classification of Chromoendoscopy Images using Homogeneous Texture Descriptors

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***Abstract*—**
**Computer-aided analysis of clinical pathologies is a challenging task in the field of medical imaging. Specifically, the detection of abnormal regions in the frames collected during an endoscopic session is difficult. The variations in the conditions of image acquisition, such as field of view or illumination modification, make it more demanding. Therefore, the design of a computer-assisted diagnostic system for the recognition of gastric abnormalities requires features that are robust to scale, rotation, and illumination variations of the images. Therefore, this study focuses on designing a set of texture descriptors based on the Gabor wavelets that will cope with certain image dynamics. The proposed features are extracted from the images and utilized for the classification of the chromoendoscopy (CH) frames into normal and abnormal categories. Moreover, to attain a higher accuracy, an optimized subset of descriptors is selected through a genetic algorithm. The results obtained using the proposed features are compared with other existing texture descriptors (e.g., local binary pattern and homogeneous texture descriptors). Furthermore, the selected features are used to train the support vector machine (SVM), naive Bayes (NB) algorithm, k-nearest neighbor algorithm, linear discriminant analysis, and ensemble tree classifier. The performance of these state-of-the-art classifiers for different texture descriptors is compared based on the accuracy, sensitivity, specificity, and area under the curve (AUC) derived by using the CH images. The classification results reveal that the SVM classifier achieves 90.0% average accuracy and 0.93 AUC when it is employed with an optimized set of features obtained by using a genetic algorithm.**

***Index Terms*—Classification, Endoscopy, Feature Extraction, Gastrointestinal, Gastric Cancer, Local Binary Patterns, Homogeneous Texture, Chromoendoscopy, Genetic Algorithm.**

## I. INTRODUCTION

In recent years, there has been an increase in the concern for gastric cancer globally [1]. An inappropriate diet is one of the main causes of complications (e.g., ulcer and inflammation) in the gastrointestinal (GI) tract [2]. In addition, these abnormalities may contribute to the development of gastric cancer [3].

An early diagnosis of tumors is useful for decreasing the mortality rate [4]. For the well-timed detection of tumors, a normal clinical practice is intestinal biopsy (in which tissue samples of the mucosa are collected and analyzed) conducted by an expert to identify if there are any cancerous or abnormal cells present in the tissue samples [5]. In contrast, endoscopy is a less invasive method for screening the GI tract. An endoscope is composed of a flexible tube with a mounted camera, light source, and surgical apparatus [6]. Therefore, an endoscope is also sometimes used for performing GI biopsies [7]. Inspection of the GI tract via an endoscope is an indispensable task for the timely identification of irregularities (e.g., cancer, ulcer, and polyps) in gastric patients. Various improvements have been made in the video endoscopy technology [8]. Chromoendoscopy (CH) is an advancement of video endoscopy [9]. CH facilitates the investigation of mucosal vascular structures by spraying dyes over the mucosal surface. The dyes make the cancerous regions more prominent visually, and several clinical studies have also utilized their benefits. Digital (virtual) CH employs image processing algorithms and uses band-pass filters to render the effect of dye-based (traditional) CH. The advantage of virtual CH over traditional CH is that there is no requirement of spraying colorants. Therefore, there is no necessity for extra cleansing that is otherwise essential before performing further endoscopic procedures [10]. An endoscopic procedure performed for a single patient can consume 45 min to 8 h of time, producing more than 80,000 frames. However, majority of the frames are discarded because of degradation or high-similarity between them. Thus, for a physician it is a rigorous and lengthy process to inspect each frame individually. Moreover, the time required by an endoscopic session also depends on the GI tract target area and skills of the endoscopist [11].

Computer-aided design (CAD) support systems can play an important role in providing a better diagnosis by enhancing the details in the endoscopic videos. CAD can also provide a second opinion to a gastroenterologist on a decision taken based on a manual analysis of the endoscopic frames [12]. Textures are basic visual features for recognizing an object. They are also useful in the examination of the abnormal regions in endoscopic frames. Textures are perceptually homogeneous and have an almost repetitive structure that is a local or global pattern distributed over an entire image [13]. Texture analysis has been an interesting area for researchers owing to its various applications in medical imaging and remote sensing. Abnormalities in the GI tract can be detected through the examination of random pit patterns and vascular structures via texture analysis of the endoscopic frames [14]. Several