Automated gastrointestinal abnormalities detection from endoscopic images

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***Abstract*—Impressive high performance reported in the use of machine learning on computer vision problems is often due to the availability of very large datasets with which deep neural networks can be trained. With inference from medical images, however, this is not the case and available data is often only a small fraction in size in comparison to benchmark natural scene recognition problems. To circumvent this problem, transfer learning is often applied, where a model trained on a large natural image corpus is adapted, or pre-trained, to model the medical problem. In this work, we consider transfer learning applied to a specific medical diagnostics problem, that of abnormality detection in the gastrointestinal tract of a human body using images obtained during endoscopy. We carry out a search over several image recognition architectures and adapt pre-trained models to the endoscopy problem. Using the benchmark KVASIR dataset, we show that transfer learning is effective in outperforming previously reported results, at an accuracy of 98.5±0.27.**

***Index Terms*—Endoscopy, Gastrointestinal abnormalities, Transfer Learning**

I. Introduction

Gastrointestinal abnormalities are very common in the world nowadays that every year millions of people get affected by various gastrointestinal abnormalities and a considerable amount of people die due to these diseases [1]. As most of these diseases can be cured, the lives lost due to these abnormalities can be saved with the proper diagnosis of these abnormalities. When considering the diagnosis procedures used for gastrointestinal abnormalities, a lot of different diagnostic procedures are being practiced around the globe. Out of those procedures, endoscopic procedures are the latest state-of-the-art procedures carried out for the diagnosis of most gastrointestinal abnormalities. Although the endoscopic procedures are most preferred all around the globe for the diagnosis of gastrointestinal abnormalities, as the diagnosis is carried out manually the diagnosis requires a large amount of time from even a trained physician. In this paper, a system is proposed that can diagnose multiple gastrointestinal abnormalities automatically from endoscopic images to assist the physicians in the diagnosis by reducing the time taken by a considerable amount compared to manual diagnosis.

In recent years there has been a significant development in deep convolution neural networks which have created a revival in image recognition and segmentation-based researches worldwide [2], [3]. Various techniques have been employed in the use of deep convolution neural networks for medical image classification. The most commonly used techniques are training of the CNNs from the scratch [4] and the use of Transfer Learning in CNNs [5]. And especially for biomedical image-based datasets as the number of images present in biomedical image datasets are comparatively lower than normal datasets due to the patient privacy and confidentiality issues in the health sector, Transfer learning in convolution neural networks can be selected to be used for the classification tasks as transfer learning can utilize the available amount of images for training and produce better classification results even with such low number of images for training. In this paper, both of the above-mentioned deep CNN techniques are explored for the automated gastrointestinal abnormalities detection from endoscopic images by deploying various CNN architectures differing in width and depth and deploying pre-trained ImageNet based CNN architectures to show how Transfer Learning can be useful in biomedical image classification-based problems in the case of a limited amount of images available for training the CNN.

II. Related work

Computer-aided abnormality detection for gastrointestinal abnormalities has been an active research field for nearly a decade now. Different researches have been done on different data sets containing different sets of images of endoscopy and wireless capsule endoscopy using different methods to predict various gastrointestinal abnormalities and diseases. Jia et al. [6] used a deep convolution neural network architecture for feature extraction and have used the extracted features to be classified using a Support Vector Machine classifier for gastrointestinal bleeding detection. The research done by Coelho et al. [7] is focused on red lesion detection and segmentation from capsule endoscopy videos. For this, they have used a unique convolution neural network architecture called U-Net. The U-Net neural network architecture was introduced by O.Ronneberger et al. [3] for biomedical image segmentation. But in this research Coelho et al [7] were able to segment the regions with red lesions rather than only identifying them. In the research done by Shvets et al. [4], the authors have focused on finding a suitable method for the detection and segmentation of Angiodysplasia using deep convolutional neural networks from wireless-capsule endoscopic images. For detection and segmentation purposes they have used various convolutional neural network architectures. For this, they have

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