AUTOMATIC SEGMENTATION OF COLORECTAL POLYPS USING DEEP LEARNING

XXXVI CONGRESO ANUAL DE LA SOCIEDAD ESPAÑOLA DE INGENIERÍA BIOMÉDICA (CASEIB2018)
CIUDAD REAL, 21-23 NOVIEMBRE 2018

L.F. Sánchez-Peralta[1], L. Bote-Curiel[1], J.B. Pagador[1], J.F. Ortega-Morán[1], F.M. Sánchez-Margallo[1], A. Picón Ruiz[2]

[1]Centro de Cirugía de Mínima Invasión Jesús Usón, Cáceres, España
[2]Tecnalia Research & Innovation, Derio, Spain

INTRODUCTION AND OBJECTIVE

Colorectal cancer (CRC) presents one of the highest incidence rates in developed countries and it is estimated that one person out of ten will suffer CRC along their lifetime [1]. Colonoscopy is the gold standard technique for detection and treatment of colorectal polyps, precursor lesions of CRC. Fully convolutional networks (FCN) are currently used in many applications for semantic segmentation with very good results in natural images [2], textures [3] or biomedical images [4]. The objective of this work is to apply a FCN for automatic segmentation of colorectal polyps in colonoscopic images.

MATERIAL

CVC-EndoSceneStill database has been used [5]. It consists of 912 colonoscopic images, which have been manually segmented, and is part of a benchmark. U-Net [4] is the selected FCN, which has been modified to add batch normalization along the whole network. This network has been selected as it has been used for medical imaging segmentation tasks with great success.

METHODS

The database has been split into training (547 images), validation (183 images) and test (182 images) sets, as indicated in [5]. Due to the limited size of the training set, data augmentation has been used (vertical and horizontal flip, width and height shift, rotation and zoom) to increase variability of the set. For training, Adam optimizer has been used, with He-normal weight initialization, learning rate equal to 0.0001 and 100 epochs. To assess segmentation, metrics indicated in the benchmark [5] have been calculated: intersection over union (IoU) and mean global accuracy (MGA). The network has been implemented in Keras using Tensorflow as backend and training has been performed in and NVIDIA GTX 1080 GPU with 8GB memory.

RESULT DISCUSION

After training the network, IoU equal to 61.17% and MGA equal to 93.37% have been obtained for the test set. **Figure 1** shows some segmentation results. These results are comparable to other published works in the field with different networks [5], [6]. Difference in the value of both metrics is due to the inclusion (MGA) or not (IoU) of the background class. If detection threshold is set to IoU>50%, U-Net correctly detect 60% of polyps in the test set. Although in line with other state-of-art works, our results might be improved by applying transfer learning (using natural or medical images), but they set the adequacy of U-Net for polyp segmentation and detection. Furthermore, using a larger publicly available dataset of colorectal polys would allow for a better trained model.

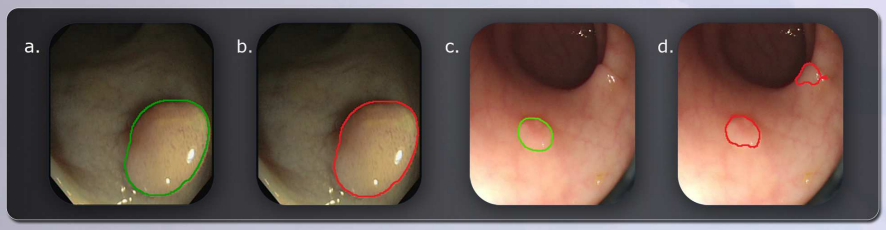

Figure 1. Ground truth (a) and segmentation at IoU=97% (b) and ground truth (c) and segmentation at IoU=60% (d)

ACKNOWLEDGMENTS

This work was partially supported by PICCOLO project. This project has received funding from the European Union's Horizon2020 research and innovation programme under grant agreement No 732111. The sole responsibility of this publication lies with the author. The European Union is not responsible for any use that may be made of the information contained therein. The authors would also like to thank Dr. Jorge Bernal and his team for facilitating the access to the database.

REFERENCES

[1] International Agency for Research on Cancer: Cancer Fact Sheets: Colorectal Cancer, https://goo.gl/pE5btv
[2] Jegou, S. et al.: The One Hundred Layers Tiramisu: Fully Convolutional DenseNets for Semantic Segmentation. 2017 IEEE Conference on Computer Vision and Pattern Recognition Workshops. Honolulu, EEUU, pp 1175–1183
[3] Andrearczyk, V., Whelan, P.F.: Texture segmentation with Fully Convolutional Networks. arXiv: 1703.05230v1 (2017)
[4] Ronneberger, O. et al.: U-Net: Convolutional Networks for Biomedical Image Segmentation. MICCAI 2015. LNCS, vol 9351. pp. 234–241, 2015
[5] Vázquez, D. et al.: A Benchmark for Endoluminal Scene Segmentation of Colonoscopy Images. Journal of Healthcare Engineering. (2017). doi:10.1155/2017/403719
[6] Wichakam, I. et al.: Real-Time Polyps Segmentation for Colonoscopy Video Frames Using Compressed Fully Convolutional Network. MMM 2018. LCNS, vol 10704. pp. 393–404, 2018

FOR FURTHER INFORMATION
Luisa F. Sánchez-Peralta lfsanchez@ccmijesususon.com
Jesús Usón Minimally Invasive Surgery Centre
Road N-521, km 41.8
10071 – Cáceres