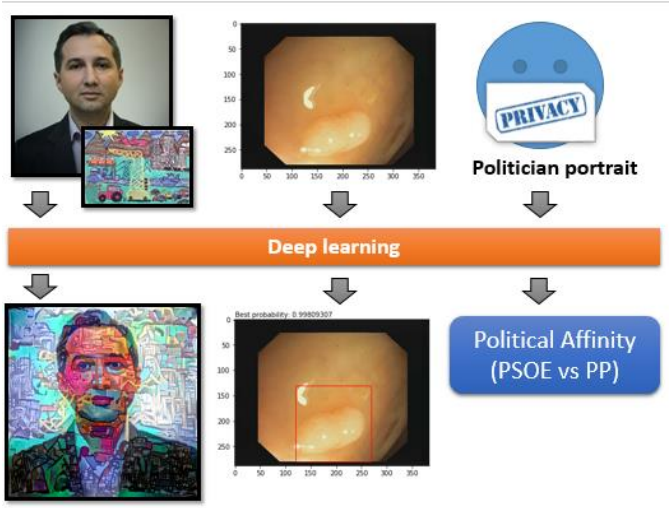
MOL2NET, International Conference Series on Multidisciplinary Sciences

Deep Learning Applications

Cristian R. Munteanu

Computer Science Faculty, University of A Coruna, Spain

Graphical Abstract



Abstract.

The manuscript presents three of my deep learning projects in 2018: mDL-ArtTranfer – Deep Learning Art Transfer using Multiple AIs, CNN4Polyps - Colonoscopy polyp detection with Convolutional Neural Networks, Deep-Politics - Prediction of Spanish Political Affinity with Deep Neural Nets: Socialist vs People's Party.

mDL-ArtTranfer is a mix of adapted scripts using three AI algorithms from fchollet, anishathalye, and ShafeenTejani (GitHub users). Thus, using content images and style pictures, three versions of art transfer will be apply with only one single call.

CNN4Polyps represents the first open GitHub repository for polyp detection and localization into colonoscopy images. The use of small CNNs with 2-3 convolutions, in only 2 minutes with GPU Nvidia Titan Xp, will generate a model with of 92%. The VGG16 transfer learning is no improving this accuracy. The fine-tuning of the last convolutional block and the full-connected layer of the pre-trained Imagenet VGG16 will generate an accuracy over 98%.

Deep-Politics is using the politician's portrait to predict the affinity for two political parties in Spain. Both small CNNs with augmented data and VGG16 transfer learning without data augmentation can generate models with accuracy over 80%. The VGG16 fine-tuning of the last two convolutional blocks and the full-connected layer will raise the accuracy to 85%.

Introduction

Deep Learning (DL) became the standard in image processing [1]. The current applications of DL use the Convolutional Neural Networks (CNN) [2] into three different projects:

- Art transfer: pixel optimization to apply a style to a picture;
- Detection and localization of the colonoscopy polys;
- Prediction of political affinity for two Spanish parties using the politician's portraits.

The results are presented as an open GitHub repositories.

Materials and Methods

Figure 1 presents the art transfer algorithm using multiple AIs, mDL-ArtTranfer – Deep Learning Art Transfer using Multiple AIs: using a content image, the AI will apply the style from other image, resulting three different version of the initial content image (https://github.com/muntisa/mDL-ArtTransfer).

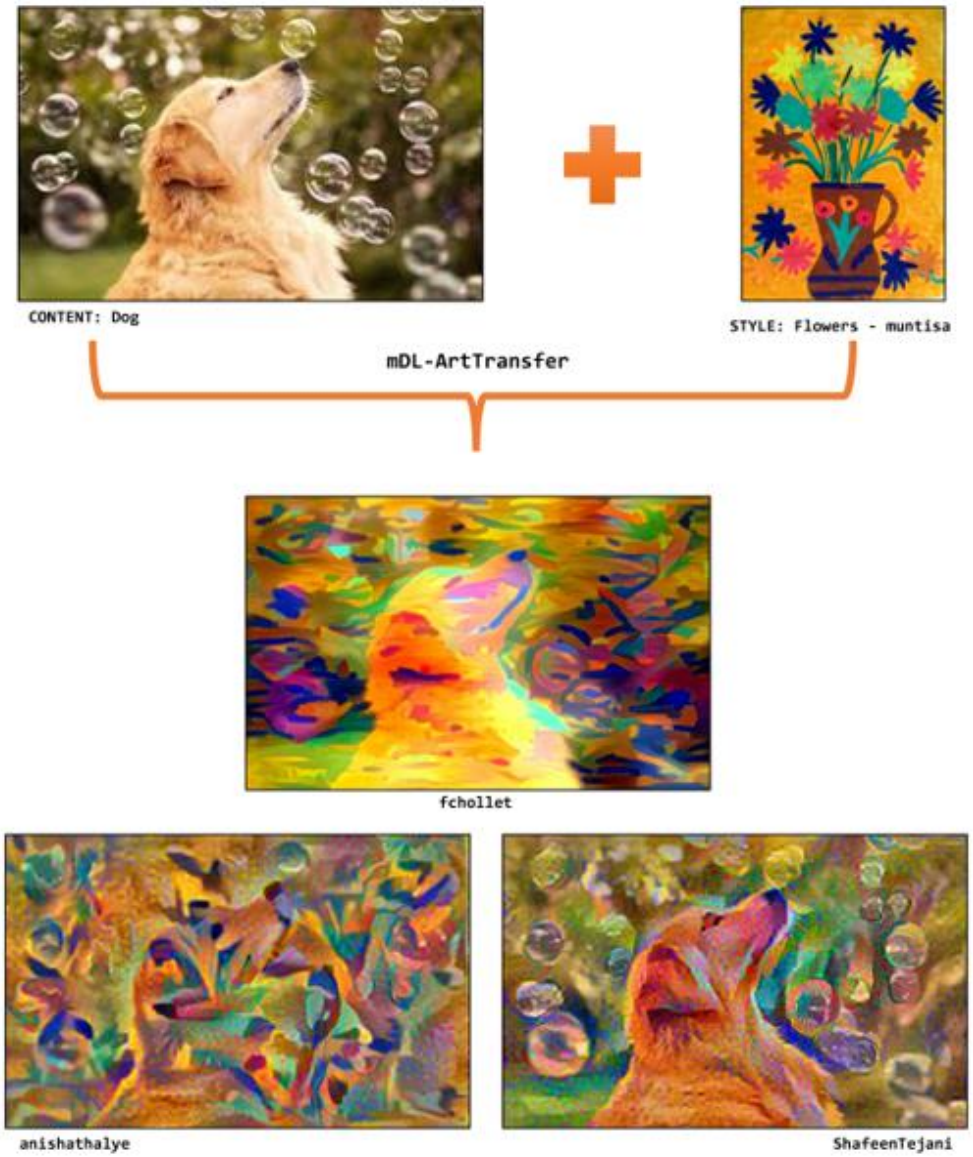


Figure 1. mDL-ArtTransfer methodology

In **Figures 2** and **3**, the flow of the jupyter notebooks are presented, starting with the original colonoscopy images [3] and ending with the polyp localization: CNN4Polyps - Colonoscopy polyp detection with Convolutional Neural Networks (https://github.com/muntisa/Colonoscopy-polyps-detection-with-CNNs).

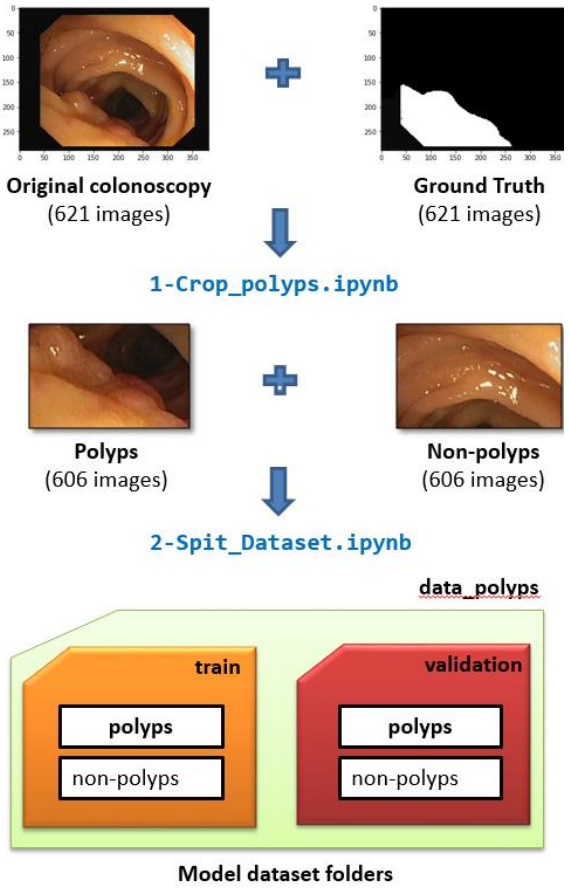


Figure 2. CNN4Polyps methodology (steps 1-2)

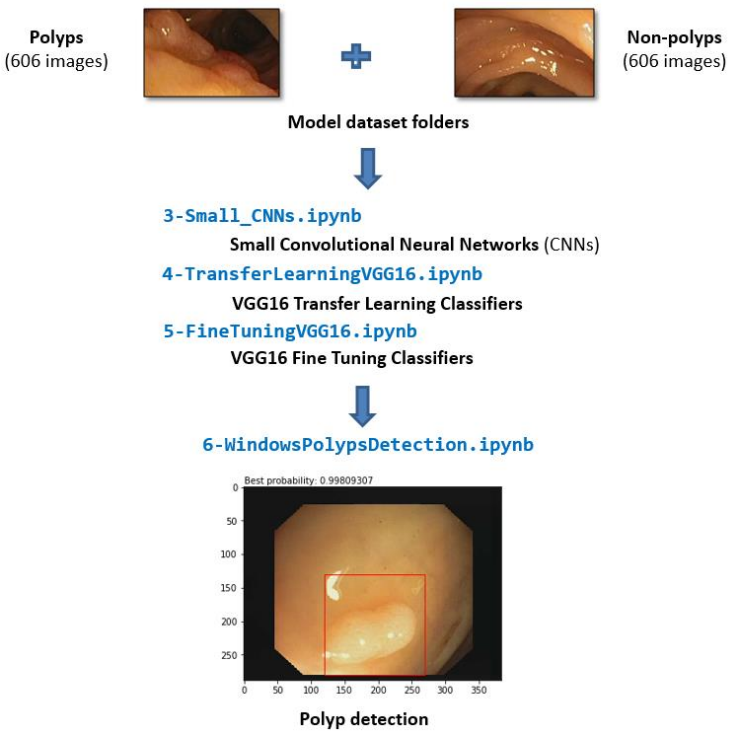


Figure 3. CNN4Polyps methodology (steps 3-6)

Figure 4. Deep-Politics methodology

Figure 4 represents the CNN methodology using inputs as politician images and output the political affinity: Deep-Politics - Prediction of Spanish Political Affinity with Deep Neural Nets: Socialist vs People's Party (https://github.com/muntisa/Deep-Politics).

Results and Discussion

Figure 5 presents a sample of the results applying art transfer (mDL-ArtTranfer) to the author portrait:

Figure 5. mDL-ArtTranfer results

An example of colonoscopy polyp detection with CNN4Polyps is presented in **Figure 6**: the poly is detected with a probability of 99.8% and localized in the entire colonoscopy image. No predictions are presented with Deep-Politics in order to preserve the personal right of political affinity.

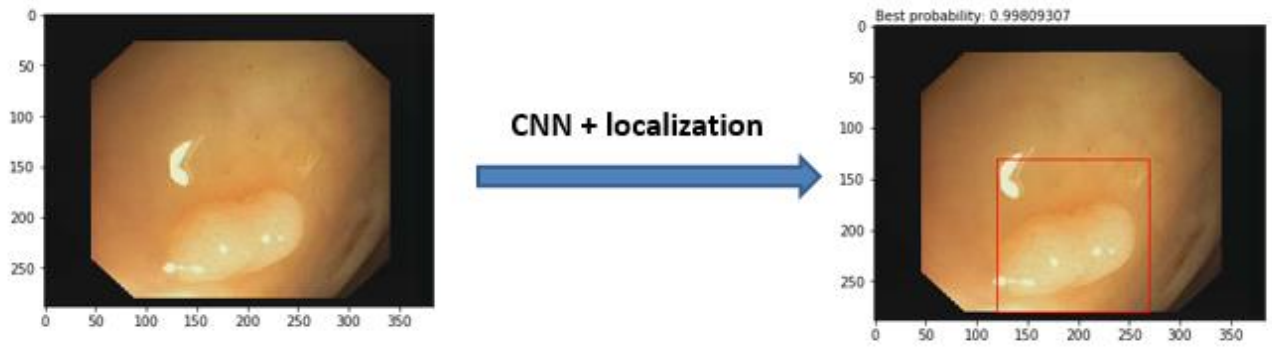


Figure 6. CNN4Polyps poly detection and localization in colonoscopy images

Conclusions

The presented projects are demonstrating the power of the CNN/DL algorithms, in different fields such as art transfer, medical imaging and politics.

Acknowledgements

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References

[1] Yann LeCun, Yoshua Bengio, Geoffrey Hinton, *Deep learning*, Nature 521, 436–444 (2015)
[2] Yann LeCun, *LeNet-5, convolutional neural networks*, http://yann.lecun.com/exdb/lenet/ (2013)
[3] Polyp detection using deep learning, http://site.uit.no/deephealthresearch/2017/07/19/polyp-detection-using-deep-learning/ (2017)