

Abstract

This diploma thesis deals with the issue of automatic separation of photos and computer graphics using deep learning techniques. With the creation of ultra realistic computer graphics that are not discernible by human eye, various risks lie in wait, such as identity theft, misinformation, manipulation, etc. Modern development and innovations in the field of machine learning and, in particular, deep learning, give the possibility of developing such powerful systems that are capable of countering the problem. With the use of deep neural networks, the whole process of classifying images, between computer graphics and photos, is automated and simplified in relation to existing systems. In this diploma thesis, we developed software in the Python programming language and with the use of the TensorFlow and Keras libraries, which include the appropriate database. The database we used for training consists of 9700 images evenly distributed in the two categories. We developed code that implements fine-tuning and transfer learning techniques for the training of a resident neural network, which achieves an accuracy of about 95%, and code for a simpler 13 layers model which reaches about 86% accuracy.

Methods used

For the first model we used a pre-trained ResNet50 that was trained on the Imagenet Dataset. The original 1000 node fully connected last layer was replaced by one with 2 to represent our classes. The second model was a simple Conv2D with 13 layers. Various preprocessing methods were used like resizing, cropping, compressing, downsampling and then oversampling. Experimenting was done with two optimizers, Adam and SGD. Where applicable due to memory restrictions, cross-validation with N=5 was used and in such cases the average metrics were used for comparison. In the case of data augmentation, simple and weighted majority vote was used.

Neural Networks Used

RESNET50

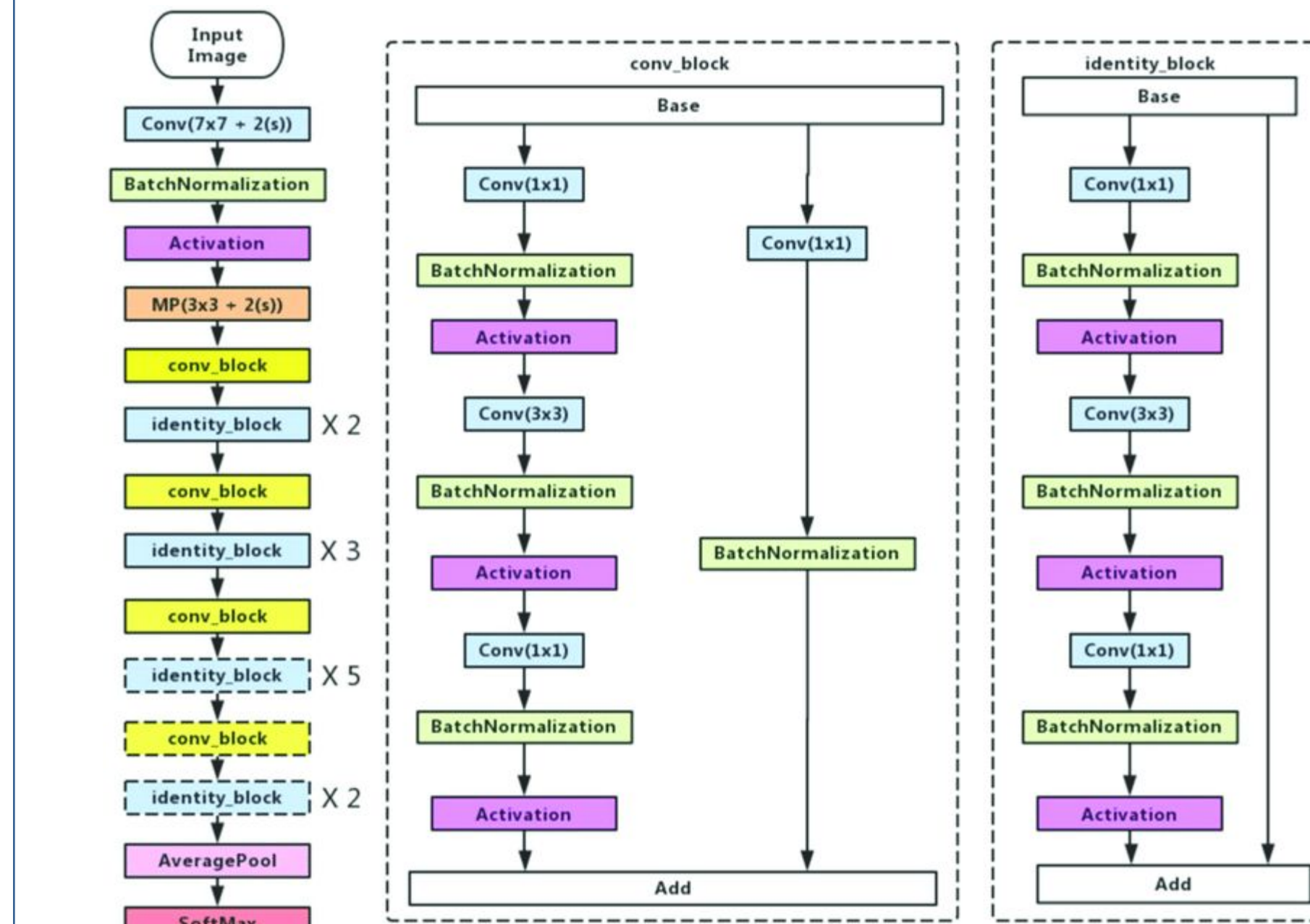


Figure 1. Residual Neural Network.

Retrain ResNet50

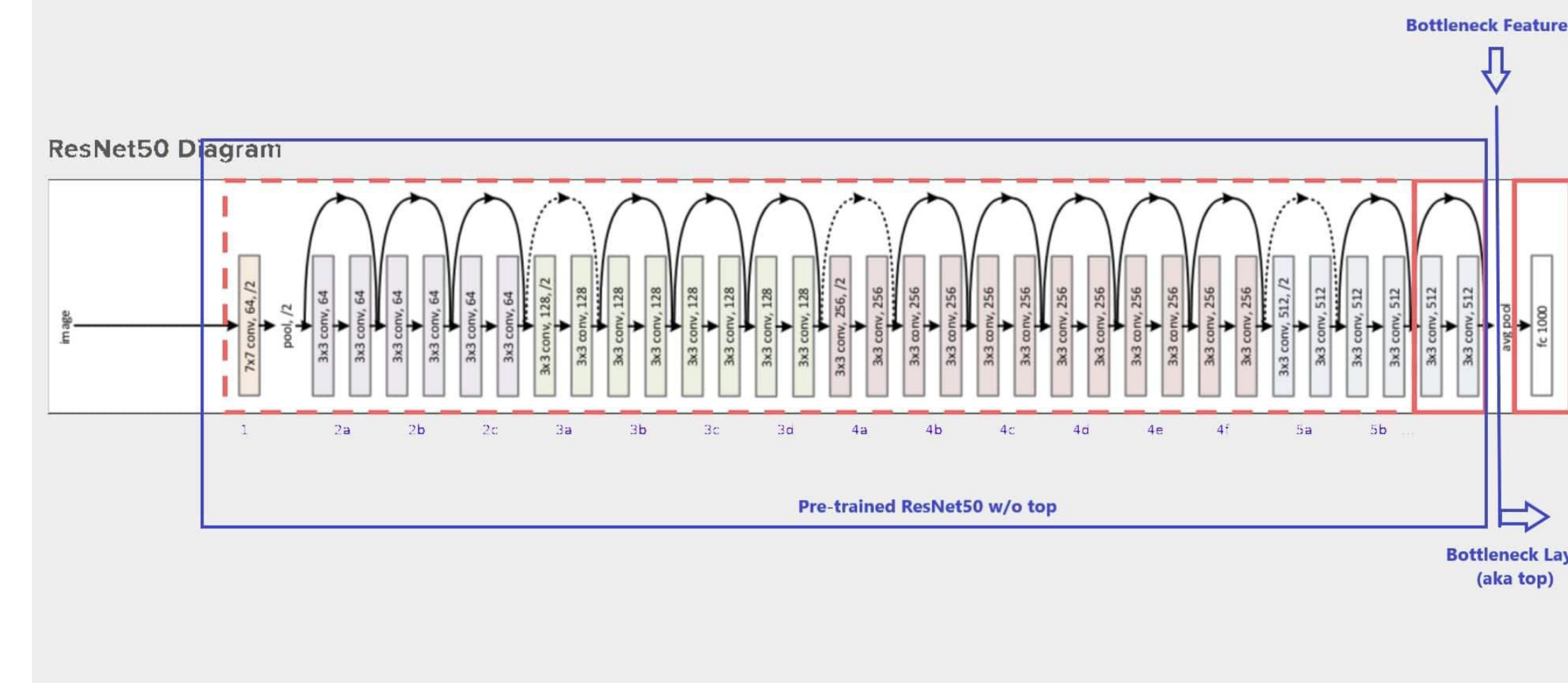


Figure 2. ResNet 50.

CONVOLUTIONAL NEURAL NETWORK

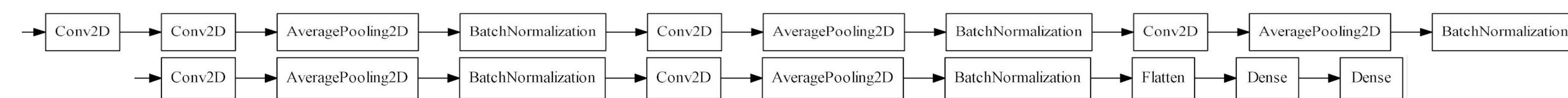


Figure 3. Conv2D with 13 Layers.

Discussion

Various models were created and many cases were examined and compared to pre existing models. The models are in no way perfect and are subject to improvement. Also, many more datasets could be used to validate the effectiveness of these models. This thesis help set the foundation for such future work.

Conclusions

As we can see from the results, cropping the center and the corners of the image for the training and using weighted voting yielded the best results for both models. This minimizes the probability for misclassification probably because in such a case for an error to happen, the classifier must either misclassify many parts of the image or to repeat the same error many times which is not a usual occurrence and thus the accuracy is higher.

Results

ResNet 50		Conv2D	
Preprocessing	Accuracy(%)	Preprocessing	Accuracy(%)
Rezing(224x224)	89.62	Resizing(224x224)	75.99
Center cropping(224x224)	88.35	Center cropping(224x224)	68.77
Center and corner cropping majority vote(224x224)	87.35	Center Cropping(100x100)	63.07
Center and corner cropping weighted vote(224x224)	95.05	Center and corner cropping weighted vote(224x224)	86.55
Downsampling and then oversampling(224x224)	91.50	Compressing and center cropping(224x224)	65.61
Compressing and center cropping(224x224)	81.63	Compressing and center cropping(100x100)	60.72
Compressing and resizing(224x224)	91.72	Compressing and resizing(224x224)	74.76

Future Directions

Future work could contain an effort to expand and optimize (e.g. the parameters, hyperparameters e.t.c.) the methodology used in this thesis. Also, it could contain an effort to extend this method to photographs that are edited or images that are a combination of photographs and computer graphics. This can be done by using fast and efficient algorithms and networks, that can pinpoint which parts of the image have been altered. Finally, it would even be possible to branch out and experiment on videos, since the videos contain thousand or even millions of frames.

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References

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