PHOTOREVAMP: REPAIR AND COLOURIZATION OF DEGRADED OR RIPPED BLACK & WHITE IMAGES

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ABSTRACT

In this paper, we propose an end to end image processing application that will enable the user to restore a Black and white, ripped-off or severely degraded old photos and convert it to a full coloured image. The colourisation will be an automatic feature which uses deep learning networks. Further, the feature of restoration of artefacts in the old image will be achieved by the help of bilinear interpolation of multiple pixels. The restoration feature requires user intervention but the implementation of the algorithm has been optimized to make the process quick. Finally, we have demonstrated the result generated by our methods on different types of scenarios, including degraded black and white images from almost a hundred-year-old photography.

INTRODUCTION

After a century of black and white cameras, the first coloured cameras were invented and brought into public use around the 1950s, yet black and white cameras were prominent until the late 20th century. This has left us with a hundred and fifty years of grayscale photographs. Some of these photographs capture important historical events like “The Solvay Conference of 1927”. Colourization is also done for personal old photographs to relive the memories of old time. This created a demand for specialized designers that colourized images manually in tools like gimp, for which designers have to be paid and significant time in order of hours is required, therefore it was not accessible to the common public economically. After computers became fast and accessible, many researchers have come up with automated solutions as opposed to manual colourization. For revamping an old ripped off photo, we have to first remove the ripped off portion of the image and then colourize it. For removing the noise due to the ripped off section, there are certain deep learning algorithms but these models require a lot of computation power and are not cost efficient. The best possible method to do this task is to use the method of bilinear interpolation. For the colourization of the black and white image, there are many different methods available. Out of all the methods, Neural networks give us the best desired output. Some of the most popular works using neural networks are Iizuka, Serra and Ishikawa (2016, p. 1) and Zhang, Isola and Efros (2016, p.649). The most successful of these neural networks are Convolutional Neural Networks (CNN) which have become the starting point of image processing in most of the machine learning models with images as input. For our project, we

have used the model given by zhang to colourize the black and white image.

METHODS

A. Stitching/Restoration of image

This process uses the input coordinates given by the user and then interpolate the pixels present at these coordinates to get the stitched output. Though, interpolating only one pixel at time may produce better result but it's becomes time consuming for restoring the high resolution images. Hence, we optimized our algorithm to stitch/interpolate 9 or more at once. As expected, this made the task a faster.

B. Colorization of black and white images

We used the technique given by Zhang to colourize black and white images. We know that an image can be represented in both RGB and LAB colour models. We will make use of the LAB colour model for the training and testing purpose.

- For getting our result, we will convert the image to LAB format and then use the L component as input to our model. The model will predict the AB components. After combination of all the 3 components, we can get our final output.
- For training, we will use a dataset of coloured images. We will convert the coloured images from RGB to LAB and then do supervised learning in which L will be the training input and AB will be the labels. After training our model will be ready to convert the black and white images to the coloured version. The neural network used was the one proposed by Zhang.

EXPERIMENTAL RESULTS

In this section, we will present the output images and the inference about the obtained results of methods.

A. *Initial Implementation of colorization feature*

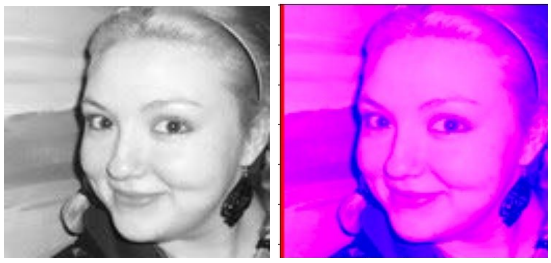

Figure 1: Colorization of image B&W image on a dataset of 10,000 images

In the beginning, we faced many issues or errors related to high computing resource requirements (high performance GPU) for training of the DL model.

Thus, we started compiling the model using a smaller dataset of 5,000 images and the obtained results were not satisfactory. Then we increased our dataset upto 10K images (popular dataset CelebAMask-HQ, which consists of photos of celebrities) and the results obtained were still not good, as also shown in Figure 1.

B. Final Implementation of colorization

As we have described in section 3A, the dataset requirement for training of such DL models are very significant.

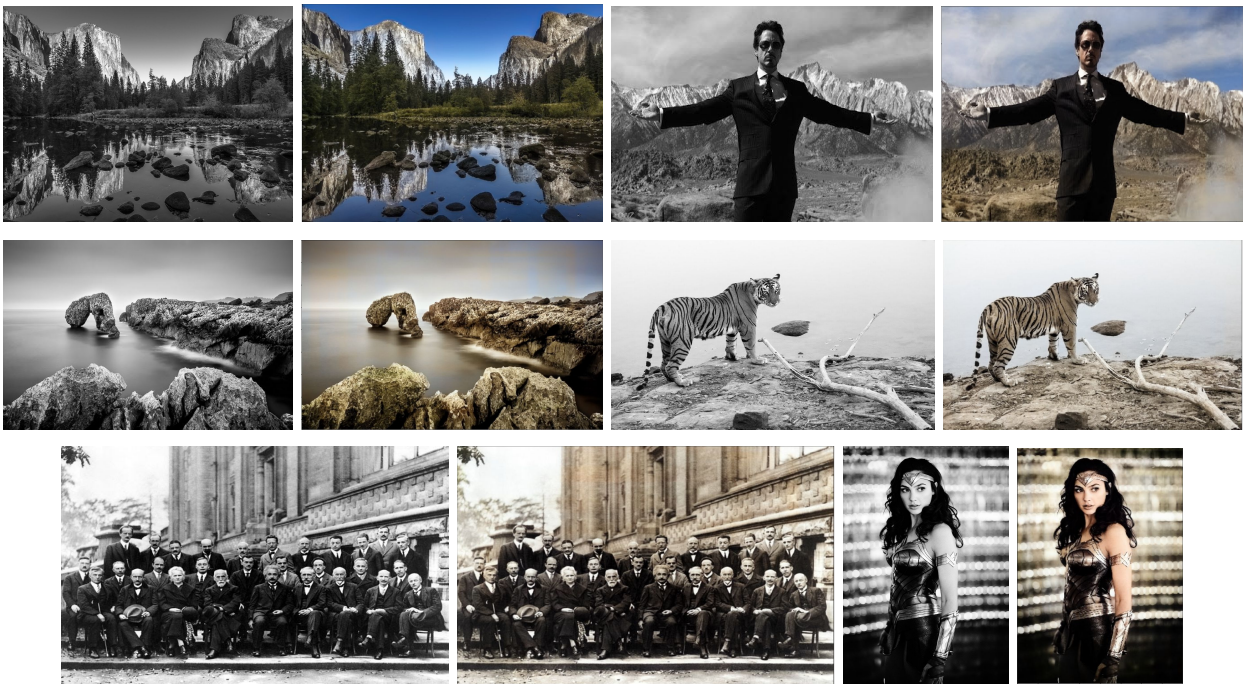

Figure 2: Result obtained by the pre-trained Zhang's model. (BW images are input and Colored images are obtained output)

Therefore, To overcome this problem, we have used a precompiled model of [1]'s algorithm. This ([1]) model is developed using the caffe framework.

In figure 2, we have shown the obtained colorization results. We can observe that colorization effects of DL network have varying response for different types of images. For instance, the response for nature scenes is more vibrant than other scenes.

C. Result for both features - Colorization and Restoration

In figure 3, we have shown a complete working flow of our application. We can observe that restoration of the image is visibly good and colorization is also optimal. However, the difference between color intensity of original image and colorized image is an inherent issue of image colorization.

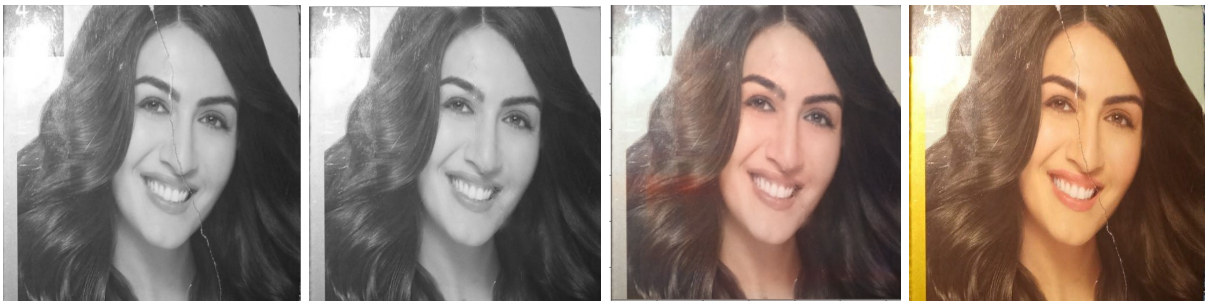

Figure 3: Stiching and Colorization of the degraded image
(Degarded image → Restored image → Colorized and Original, from left to right)

CONCLUSIONS

We have proposed an application that can handle complex image processing tasks of restoring and colorizing an old black and white image with minimal user intervention. Generally, these tasks are done by professionals or photo editing labs and it is a very time consuming task even for the professionals. Therefore, the proposed application will empower the user to do restoration and colorization of any image very quickly and even without any prior knowledge of image processing. Moreover, such software will also be an useful application for revamping historical paintings and photographs.

REFERENCES

[1] Zhang, R., Zhu, J.Y., Isola, P., Geng, X., Lin, A.S., Yu, T. and Efros, A.A., 2017. Real-time user-guided image colorization with learned deep priors. arXiv preprint arXiv:1705.02999.

[2] Colorizing B&W Photos with Neural Networks