# Personalized Image Enhancement using Machine Learning

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Automatic image enhancement is an active field of research and is used widely in professional image processing software. For our project, we want to create an automatic image enhancement tool that learns a user's preferences so that subsequent images can be automatically enhanced in a personalized way. Our work will be mainly derived from [1]. The parameters learned in [1] are associated with contrast and color correction. We will attempt to learn these parameters, and if time permits, experiment with other parameters as well.

The first part of this project is to select an optimal subset of training images from a large set of images, using the optimization technique described in [1] and [3]. The subset will be around 15-20 training images. For each training image, there will be a large possible number of combinations of parameters (depending on how many we choose to learn). To reduce the subset of possible parameter combinations used for training, we can apply the same optimization mentioned earlier. In the end, we will get 8-10 "optimal" parameter combinations per training image, which again represent the parameter space maximally. By doing these two steps, the amount of training time per user is lower, and the number of computations to train is also lower. After we have our training set, we will perform user studies on 5 to 7 subjects to acquire personalized training data. The parameter selection algorithm essentially uses a distance metric to find the closest neighbor in the training set to the test image and applies the parameters accordingly. We plan to form an optimal linear combination of multiple distance metrics to best match the test image. We will then test our algorithm and compare results to a few professional auto enhancement tools.

Also, if time permits, we would like to make the enhancement tool more content aware using some principles mentioned in [2]. Techniques in [4] can also be used to preprocess the image before the personalized enhancement step.

In conclusion, we expect the results of the user study to indicate whether or not people would prefer a personalized enhancement tool over a conventional auto-enhancement tool found in common image processing software.

We will **NOT** be using an Android device

References:

[1] Kang, Sing Bing, Ashish Kapoor, and Dani Lischinski. "Personalization of image enhancement." *Computer Vision and Pattern Recognition (CVPR), 2010 IEEE Conference on*. IEEE, 2010.

[2] Kaufman, Liad, Dani Lischinski, and Michael Werman. "Content‐Aware Automatic Photo Enhancement." *Computer Graphics Forum*. Vol. 31. No. 8. Blackwell Publishing Ltd, 2012.

[3] Krause, Andreas, Ajit Singh, and Carlos Guestrin. "Near-optimal sensor placements in Gaussian processes: Theory, efficient algorithms and empirical studies." *Journal of Machine Learning Research* 9.Feb (2008): 235-284.

[4] Celik, Turgay, and Tardi Tjahjadi. "Automatic image equalization and contrast enhancement using Gaussian mixture modeling." *IEEE Transactions on Image Processing* 21.1 (2012): 145-156.

## Timeline/ Milestones

- Implement the auto enhancement preprocessing step
- Use BFGS algorithm to find the best linear combination of distance metrics using the entire training set.

**First Milestone (finished by 11/14): Finished with preprocessing steps and calculation of optimal distance metric**

- Implement optimization algorithm (the one mentioned in the proposal, from [1] and [3])
- Use optimization algorithm to choose the training images that maximally represent the entire training set.
- Use optimization algorithm to choose the best parameter combinations for each optimal image

**Second Milestone (finished by 11/24): At this point, we will have our optimized set of training images and will be ready for user studies**

- Implement learning algorithm framework
- Implement GUI for the user study
- Do the user study for 5 - 7 people

**Third Milestone (finished by 12/5): At this point, we will have completed the project. Time permitting, we can possibly add more auto-enhancement features to the pipeline.**