Cathy Chen, Zachary Liu, Lindy Zeng
cc27, zsliu, lindy
COS 429 — Prof. Olga Russakovsky
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Final Project Milestone (Face Recognition)

Team members: Cathy Chen, Zachary Liu, Lindy Zeng

Problem description: What is the robustness of face recognition algorithms to image transformations?

Outline of proposed approach: We will train various facial recognition algorithms on one face dataset. We will change the style of the face images and transform the face images through transformations such as flipping, rotation, illumination, and style changes, to test generalization beyond the images provided in the dataset. We intend to test face recognition algorithms such as PCA, LDA, and HMM.[2] We will rely on existing implementations[6] of these algorithms to ensure consistent accuracy. We will implement the transformations ourselves, so that we can better control the amount and type of transformation.

Our proposal is partly motivated by findings in psychology literature. Previous studies of "super-recognizers" (people with extraordinarily high powers of face recognition) are more negatively affected by face inversion.[5] We want to examine whether the same effect happens with face recognition algorithms in computer vision.

We are also interested in exploring how face memorability by humans is correlated with algorithmic accuracy. Bainbridge has shown how memorability is an intrinsic characteristic of a face not related to viewpoint.[7] We hope to investigate whether the memorability of an image is correlated with recognition accuracy.

Pointers to Related Course Topics: We studied several variation of face detection algorithms in the course. For example, in the second assignment, we implemented a face detector using a Histogram of Gradients (HoG) model. In the third assignment, we implemented a face tracker using the Lucas-Kanade algorithm. During lecture, we also covered face detection in Viola-Jones using Haar-like filter rectangles, and how a face can be represented and detected using a Bag-of-Words model.

Plans for acquiring the necessary data/computational resources: Our project requires a dataset for face detection, and we plan to begin with the FERET database.[3] However, we may also move to the LFW face database for more variation.[4] As a separate test of robustness, we can expand to the cartoonFaces database to test different styles of representation.[1]

To gather image memorability scores, we plan to use the online API and/or pretrained model provided by the Large-Scale Image Memorability project.[9]

Target outcome (deliverable): In our write-up and poster, we will present a comparison of the algorithms' performance to different types of transformations. We will use recognition accuracy to evaluate how well each algorithm performs under the various transformations.

We will also present an analysis of different areas of weakness (if any) of each algorithms. For instance, we hypothesize that certain methods may be more robust to specific types of transformations.

As a stretch goal, we want to explore correlations between predicted memorability scores, as produced by existing predictive models[8,9], and how different transformations affect the recognition accuracy of different algorithms.

Fallback plan (roadblocks, minimum deliverable): One potential problem is that the algorithms might perform too well even with image manipulations. For instance, if they all perform near 100% even with manipulated images, then the analysis will be uninteresting. If this happens, we can reduce the number of training examples or search for databases with more challenging images. We do not believe that computing power will be a problem, as we will test statistical methods such as PCA (as opposed to training large neural networks).

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4. "LFW Face Database : Main." Accessed December 11, 2017. http://vis-www.cs.umass.edu/lfw/.
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6. "Face Recognition Algorithms and Databases." Accessed December 13, 2017. https://pythonhosted.org/bob.bio.face/
7. Bainbridge, W.A. "The Memorability of People: Intrinsic Memorability Across Transformations of a Person's Face." *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 43(5), 706-716. http://psycnet.apa.org/record/2016-59853-001
8. Dubey, Rachit et al. "What Makes an Object Memorable?" The IEEE International Conference on Computer Vision (ICCV), 2015, pp. 1089-1097. https://www.cv-foundation.org/openaccess/content_iccv_2015/html/Dubey_What_Makes_an_ICCV_2015_paper.html
9. Khosla, Aditya et al. "Understanding and Predicting Image Memorability at a Large Scale." International Conference on Computer Vision (ICCV), 2015. http://memorability.csail.mit.edu