Automated Tinder

Tanner Clark

1 Goal

This project's goal is to explain how eigenfaces could be used to create a simulated program that automatically matches you with potential Tinder candidates.

NOTE: *This project is more for a theoretical use of the mathematical components behind eigenfaces. The author feels that the humor and satirical nature of this topic makes for a more lighthearted approach to a difficult concept. The satire arises from the author's view of the efficacy and justification of Tinder.*

2 Project Description

This paper is about an automated tinder, which is a tinder that would swipe for you. During this paper we will talk about what tinder is, about eigenfaces, and how they can be used together.

Tinder is a type of dating app. You input where you are located and the age range of people you would be interested in, and the app shows you everyone around your area in the age range. You the user either swipe left (say you don't like the person), or swipe right (say you like them). After doing this if the person also swiped right to you you are then matched and can chat/meet up if you choose to. Wouldn't it be nice if this app would do the swiping for you, so you don't have to take the time doing that. By using eigenfaces we can do just that.

3 Computation of Eigenfaces

For the presentation, certain variables were ignored for efficiency, sense of proof, and ease. However, for this research, variables will be considered and thoroughly examined.

To compute your eigenfaces, you must receive a sample of photos that you want to be evaluated using this method. For this application, you would collect forty to fifty pictures of "pre-approved" individuals. The pictures must the be turned into matrices [1] where each pixel correlates to a specific value in a matrix. [2]

Assuming that the pictures are centered and transformed into equal valued matrices where each image matrix is a NxN square matrix, matrices are turned into vectors images I_1,I_2,I_3...I_M where M is the number of images and I_M are now N^2x1 vectors. Standardizing the faces is required. Thus, computing an average face value A:

$$A = \frac{1}{M}\sum_{i=1}^{M} I_i$$

Next, subtract the mean face from the each image vector:

$$V_i = I_i - A$$

Next, the covariance matrix is needed to evaluate the variance between the different images. From there, we can determine the eigenvectors of this covariance matrix and yield our eigenfaces. Let the Covariance matrix C be:

$$C = \frac{1}{M}\sum_{i=1}^{M} V_i V_i^T = BB^T$$

[1] Transforming an image into a matrix varies between coding language

[2] Note that centering and transformation algorithms are suggested to improve accuracy of the program. This research will assume that those algorithms are in place thus ignoring the computation and mathematical procedure to construct them.

where

$$B = [V_1, V_2, V_3 ... V_M]$$

Note that BB^T is a N^2xN^2 matrix. Consider B^TB. This is a MxM matrix which is far more practical to compute eigenvectors of.

Compute the eigenvectors v_i of B^TB.

$$Bv_i = u_i v_i$$

What is the relationship between u_i and v_i?

$$B^T Bv_i = u_i v_i => BB^T B_v i = u_i Bv_i => CBv_i = u_i Bv_i$$

or

$$Cu_i = u_i u_i$$

where

$$u_i = Bv_i$$

Thus, BB^T and B^TB have the same eigenvalues and their eigenvectors are related as follows: $u_i = Bv_i$

Note that BB^T can have up to N^2 eigenvalues and eigenvectors. Also note that B^TB can have up to M eigenvalues and eigenvectors. Finally, the M eigenvalues of B^TB (along with their corresponding eigenvectors) correspond to the M largest eigenvalues of BB^T (along with their corresponding eigenvectors).

Next is to compute the eigenvectors of BB^T such that $u_i = Bv_i$ where $||u_i|| = 1$. Each face (minus the mean) A in the training set can be represented as a linear combination of the best K eigenvectors:

$$B_i - A = \sum_{j=1}^{K} w_j u_j$$

where

$$w_j = u_j^T B_i$$

The u_j's are the eigenfaces.

Our application of this is quite simple. In the automated tinder you will have to first do a specific amount of swipes. The amount will depend on how accurate you want the date to be. The faces of the people you swiped right to will then be put into the eigenface program as images. This program combines all of the faces to construct your ideal man/woman in an eigenvector sense. Then, the automated tinder compares the vectors of this ideal face to the vectors of all other potential matches. If the potential match is close to this ideal face, then tinder will swipe right for you. Otherwise it will swipe left.

4 Literature Search

For our literature search we located an article online where someone has actually made a program and an app for an automated tinder. His application will swipe right or left for you, and then if it swipes right it will also send a message to the ones you match with. This application is known as Tinderbox.

Just like the program we worked with, Tinderbox uses eigenfaces to implement facial recognition. Tinderbox uses the Viola-Jones framework to extract faces from Tinder. The Viola-Jones framework is an algorithm that is used to detect either faces or other objects. After Tinderbox has extracted the faces it then converts them to grayscale. Only pictures with identifiable faces are used to prevent a false positive when using the application. It then normalizes the images and converts the pixels into a matrix where they are then appended to a list of models. The models are then averaged into a single face used for future comparison. Tinderbox requires you to make 60 swipes yourself before it has enough data to swipe for you.

Another feature of this application is the ability to undo a swipe if Tinderbox swipes right to someone that you do not actually find attractive. It also allows you to change your location preferences in the instance that you move or go somewhere for travel. The last feature is that Tinderbox can also send messages for you. It analyzes messages you receive and determines if it is a positive or negative message. If it is a positive message Tinderbox replies with a preprogrammed message, and if this happens twice then it notifies you of a good match. Similarly, if you get a negative message Tinderbox will notify you.

5 Conclusion

Automated tinder is just one of the applications of eigenfaces. And even so, eigenfaces are just one form of a mathematical comparison between facial images. However, they seem to yield strong results making them useful in applications where facial comparisons are needed. In our experiment, we explored one creative possibility for eigenface application. Automating Tinder has other social and emotional aspects that would affect its actual accuracy and creditability but mathematically, it is very possible.

References

[1] *"Eigenface."* Wikipedia, Wikimedia Foundation, 4 Dec. 2017, en.wikipedia.org/wiki/Eigenface.

[2] Long, Justin *"Automating Tinder with Eigenfaces."*. Automating Tinder with Eigenfaces, crockpotveggies.com/2015/02/09/automating-tinder-with-eigenfaces.html.

[3] M. Turk and A. Pentland, *"Eigenfaces for Recognition"*, Journal of Cognitive Neuroscience, vol. 3, no. 1, pp. 71-86, 1991.