Senior Project – Computer Science and History I.D. – 2014

Automatic Age Estimation and Interactive Museum Exhibits

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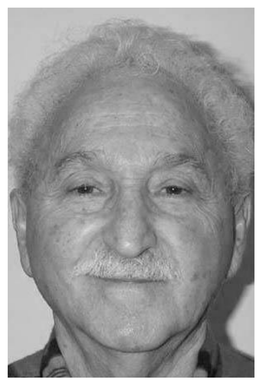
Abstract:

Through the use of video sensing equipment, museums can create exhibits that leverage multimedia to provide a more rich learning experience. By using this equipment to determine the approximate age of those viewing an exhibit, it is possible to provide additional interactivity that is tailored to meet their age demographic and provide a more engaging experience.

Approach:

We are performing age recognition by first using feature extraction to gain usable data from an image and then using the Random Forest machine learning algorithm to attempt classification within three age groups: 18 – 33, 34 – 64, and 65 – 92. The two extraction methods being used are Principal Component Analysis and Fisherfaces.

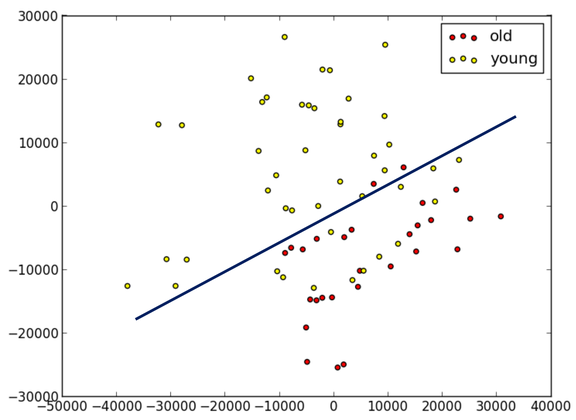


Samples of the 181 facial images used.

Kennedy, K. M., Hope, K., & Raz, N. (2009). Lifespan Adult Faces: Norms for Age, Familiarity, Memorability, Mood, and Picture Quality. *Experimental Aging Research*, 35(2), 268-275.

Principal Component Analysis:

PCA reduces the complexity of an image by reducing the number of features in its dataset from the total number of pixels, to a defined number of dimensions. These components are created from correlations in the data that are most important to maintaining the datasets overall integrity while reducing its complexity.

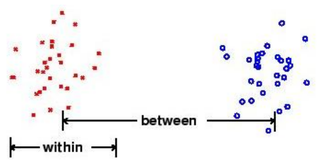


Graph of the separation between old and young males along two dimensions.

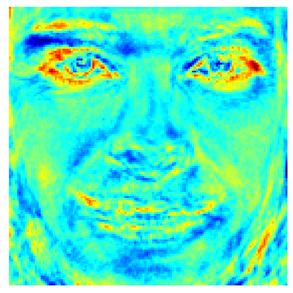
The drawn blue line shows a rough division between the two groups over these dimensions.

Fisherfaces:

Fisherfaces is an algorithm designed to perform facial recognition between defined classes, in this case age group. It finds the facial features that differentiate between the input classes through Linear Discriminant Analysis. LDA seeks to rotate the axes upon which the classes are projected to minimize the difference between members of the same class while maximizing distance between classes .



Example of desired projection of classes in two dimensions.
dtreg.com/lda.htm



Example of Fisherfaces highlighting the features that differentiate between two classes.
Opencv.org

Results With PCA:

- Classification accuracy is higher when one gender is tested at a time.
- Males are easier to classify than females.
- Ages 34 - 64 are difficult to accurately classify with this approach regardless of gender, severely limiting the overall accuracy of the approach.

PCA Performed Over 5 Dimensions			
	Successful Classification Percentage		
Age Groups	Only Males	Only Females	Both Sexes
18 - 33	90.9090	78.0487	68.8524
34 - 64	16.6666	22.2222	25.0000
65 - 92	78.5714	64.5161	72.8813
All Ages	72.2222	62.2222	60.2564

Future Work:

We plan on comparing the current PCA implementation with results from the not yet completed Fisherfaces method to determine which is more accurate. Furthermore, we aim to expand upon the system by performing a step before age classification to determine the subject's gender beforehand to help increase accuracy. Additionally, we plan to expand upon the implementation by creating an interface for museum websites that uses input from the user's webcam.