Week 3&4: Summer Internship

9 June 2021- 22 June 2021

Tasks

The task in week 3 was to extract features from the image using Non-Negative Matrix Factorisation technique (NMF Technique).

The next task was to do image search on the output that highlights the features to get the original image.

Plan

The tasks was planned to be done in 3 steps.

- Get faces from the images.
- Apply the algorithm to get eigenfaces and NMF features.
- Search with the output on various engines.

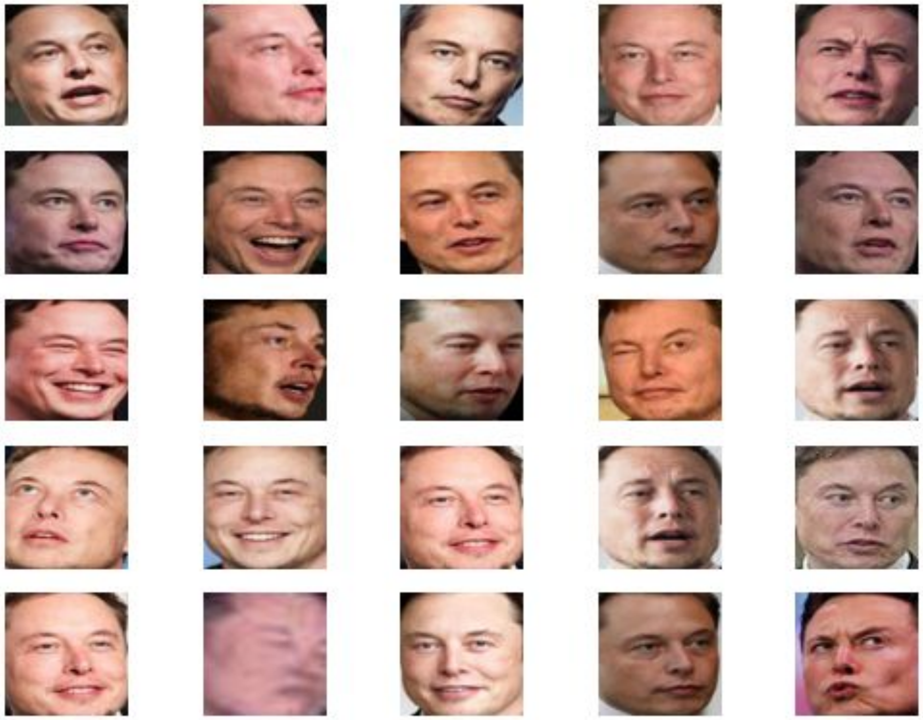
Face extraction

This step is required as a pre-processing step before executing the NMF algorithm.

This step takes images as input and gives the faces as the output in .npz format using deep learning.

Output

Extracted faces from images of the dataset.



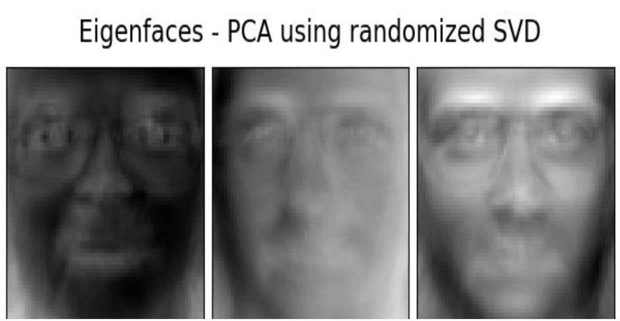
Extracting images using NMF Technique

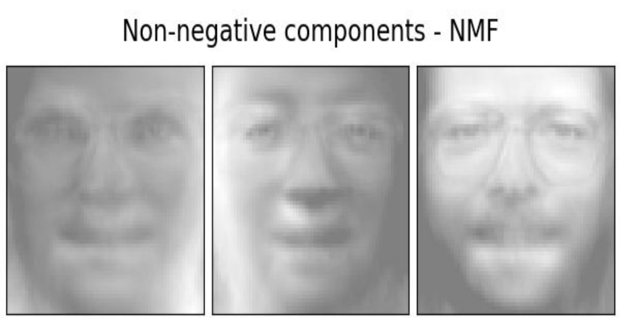
The output we are expecting is the NMF components and the eigenfaces.

This output represents the features corresponding to the images in the dataset.

The idea to use this features to search for the images in the search engines.

Output

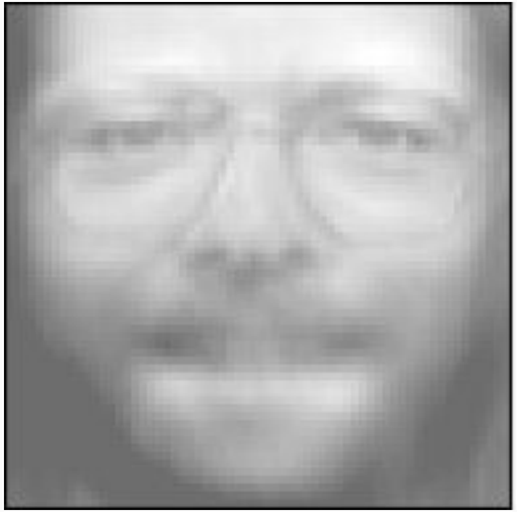




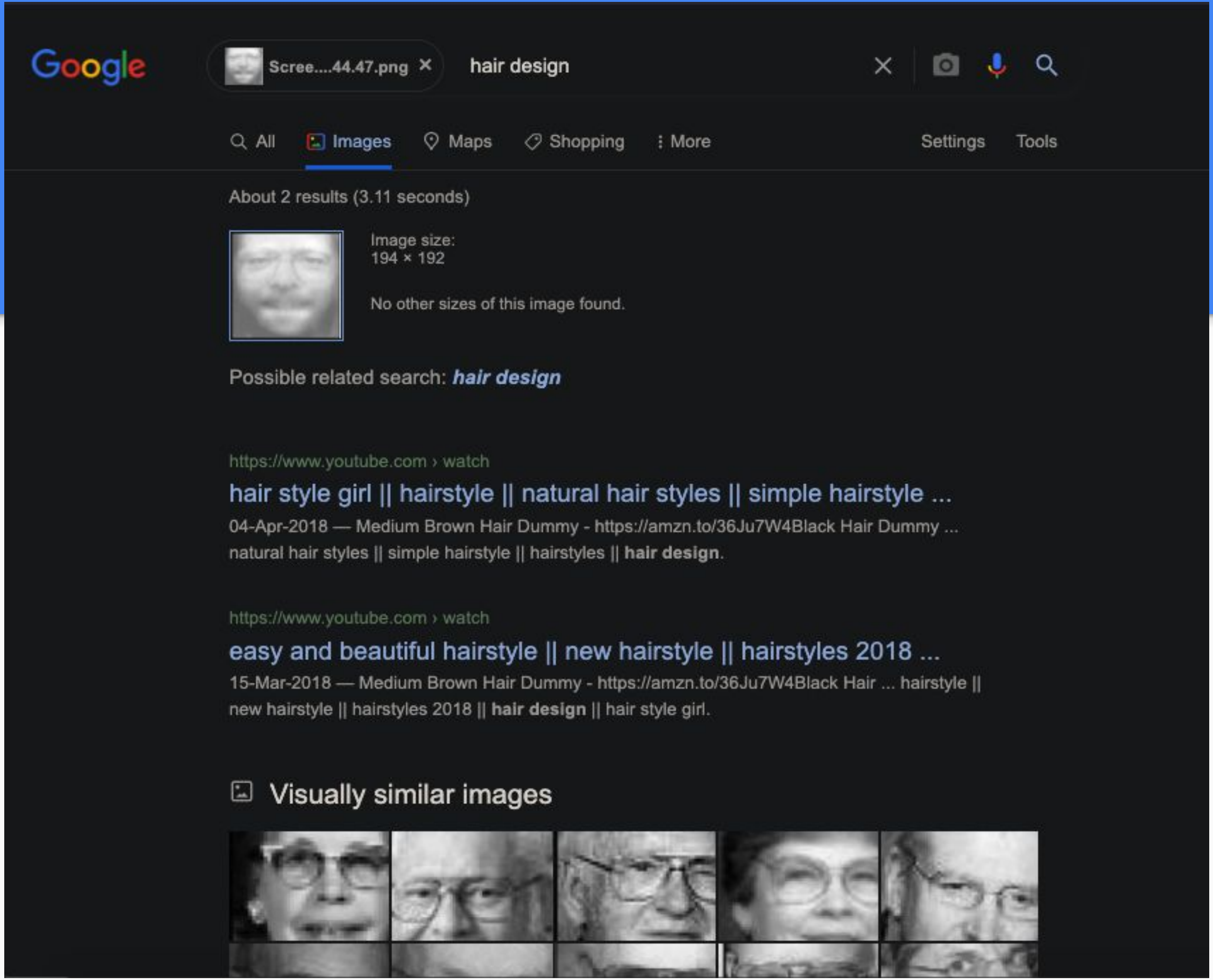
Eigenfaces corresponding to the dataset

NMF components corresponding to the images in the dataset

Output from NMF features



Tested at:
https://images.google.com/



About 2 results (3.11 seconds)

Image size:
194 × 192

No other sizes of this image found.

Possible related search: ***hair design***

https://www.youtube.com › watch

hair style girl || hairstyle || natural hair styles || simple hairstyle ...

04-Apr-2018 — Medium Brown Hair Dummy - https://amzn.to/36Ju7W4Black Hair Dummy ... natural hair styles || simple hairstyle || hairstyles || **hair design**.

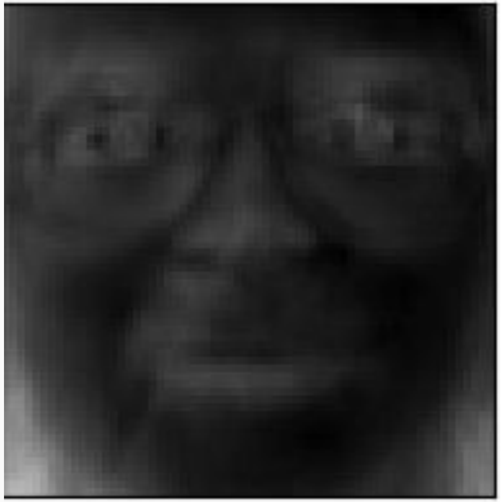
https://www.youtube.com › watch

easy and beautiful hairstyle || new hairstyle || hairstyles 2018 ...

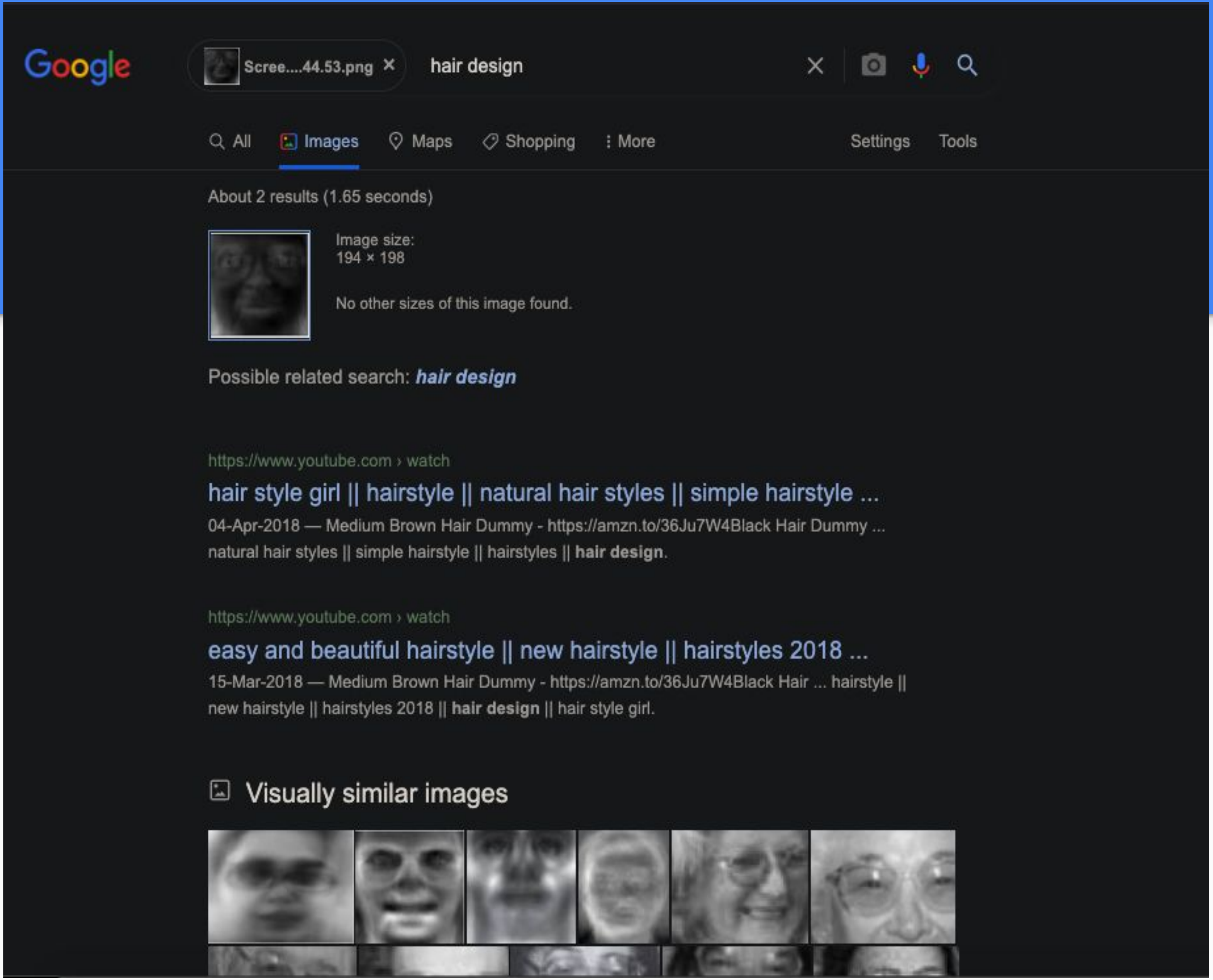
15-Mar-2018 — Medium Brown Hair Dummy - https://amzn.to/36Ju7W4Black Hair ... hairstyle || new hairstyle || hairstyles 2018 || **hair design** || hair style girl.

Visually similar images

Output from eigenfaces



Tested at: https://images.google.com/



hair design

About 2 results (1.65 seconds)

Image size:
194 × 198

No other sizes of this image found.

Possible related search: ***hair design***

https://www.youtube.com › watch

hair style girl || hairstyle || natural hair styles || simple hairstyle ...

04-Apr-2018 — Medium Brown Hair Dummy - https://amzn.to/36Ju7W4Black Hair Dummy ... natural hair styles || simple hairstyle || hairstyles || **hair design**.

https://www.youtube.com › watch

easy and beautiful hairstyle || new hairstyle || hairstyles 2018 ...

15-Mar-2018 — Medium Brown Hair Dummy - https://amzn.to/36Ju7W4Black Hair ... hairstyle || new hairstyle || hairstyles 2018 || **hair design** || hair style girl.

Visually similar images

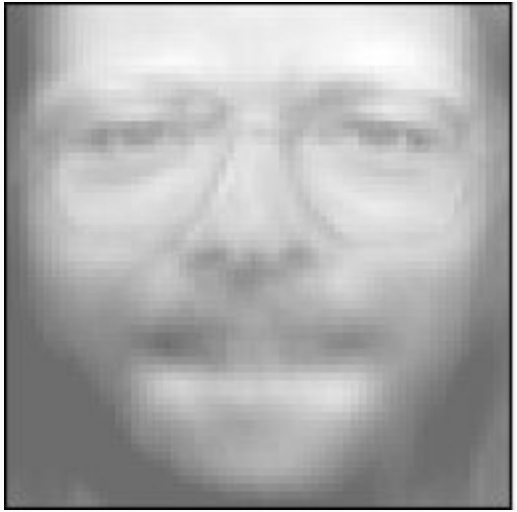
Inference from the output of google images

One of the main observation about the behaviour of google images is that it only looks for visually similar images and text in the image and give the output accordingly.

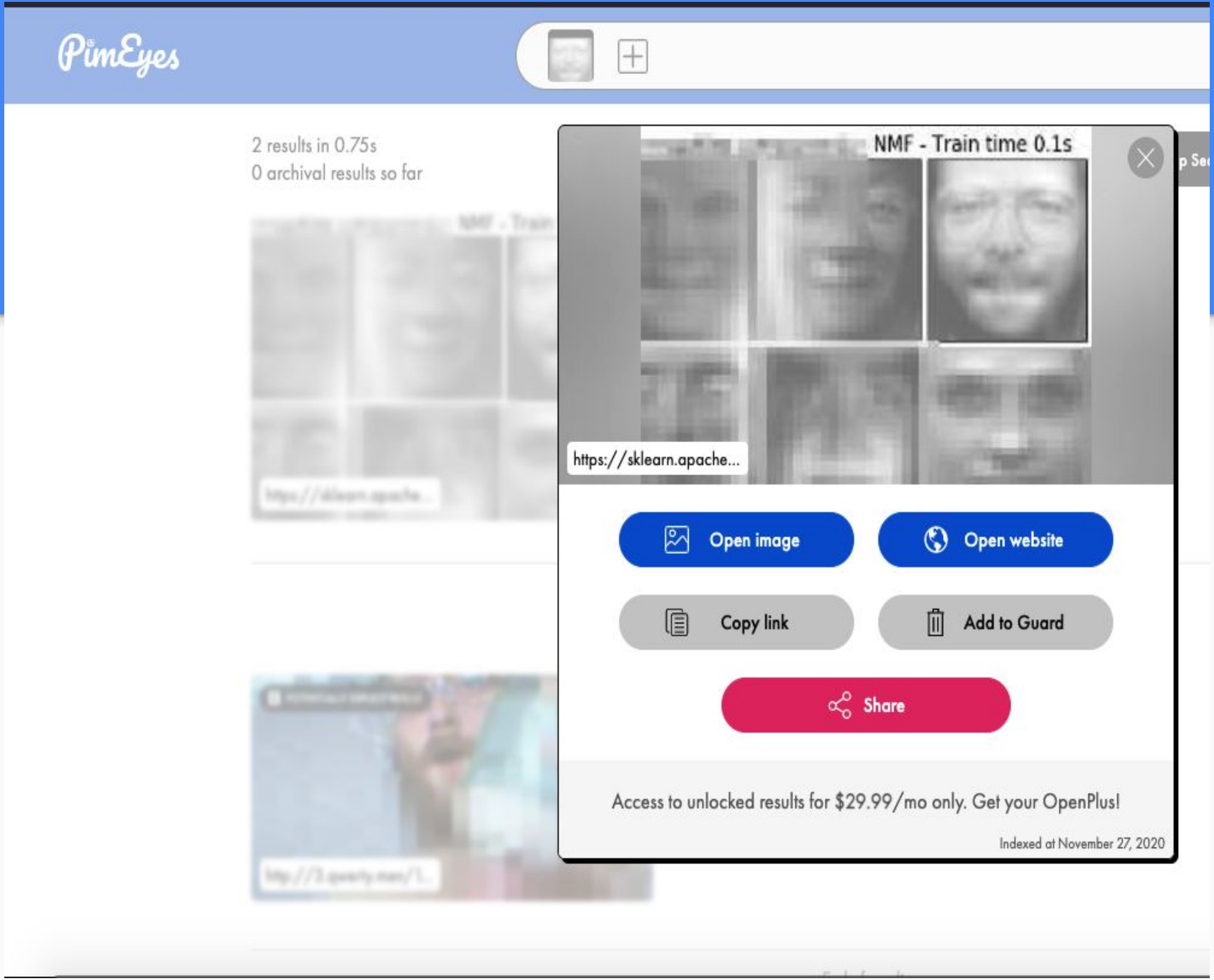
Although it might do that in some cases, but it is not meant for deep fake detection, retrieving the original etc.

Restricted search is available only for text in Google search engine and not for images.

Output from NMF features



Tested at:
https://pimeyes.com/en



2 results in 0.75s
0 archival results so far

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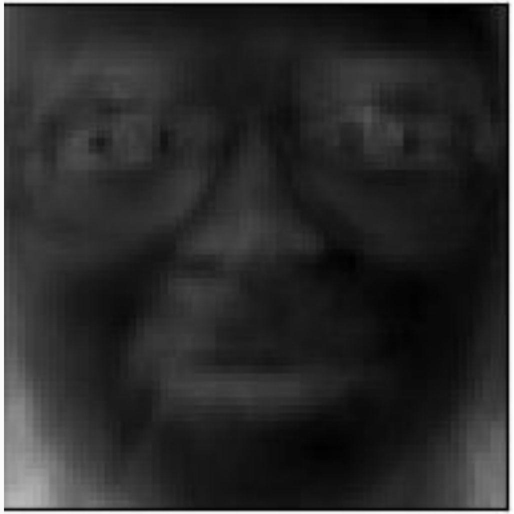
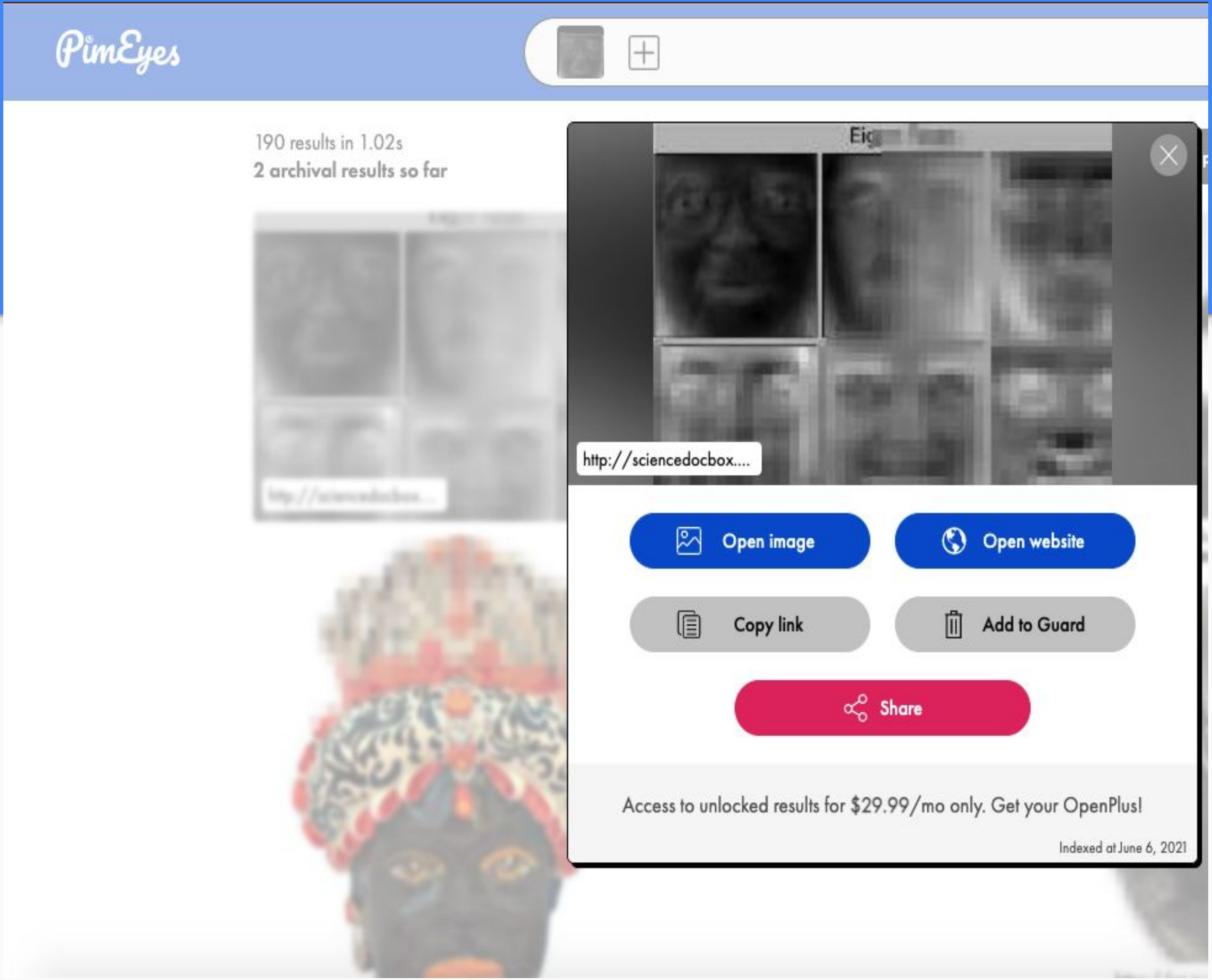
Indexed at November 27, 2020

Output from eigenfaces



Tested at: https://pimeyes.com/en



190 results in 1.02s

2 archival results so far

http://sciencedocbox....

Access to unlocked results for $29.99/mo only. Get your OpenPlus!

Indexed at June 6, 2021

Inference from the output of pimeyes

Reverse search engines such as pimeyes are more successful than google images in getting the source where this image (or similar image) appears.

It however did not return the original image, but it gave the source where the eigenfaces/NMF faces were present.

References

Link: https://ieeexplore.ieee.org/document/6364801

This paper talks about the technique used in extraction of features. The code for the same is pushed in the repository.

Link to the repository: https://github.com/Deepanshu-Rohilla/intern

Tasks

The main task in week 4 is to get the features from an image to compare two images using features and give a similarity score.

The first part is to separate the face from the image and then apply the comparison algorithm.

Comparison-1

For this, we will use the notion of “norm” in a vector space. Using linear algebra, we know that “norm” behaves similarly as the distance and the difference in norm would thus become the parameter for comparison.

We used the standard norm function from opencv called **cv.NORM_L2.**

Matching the features

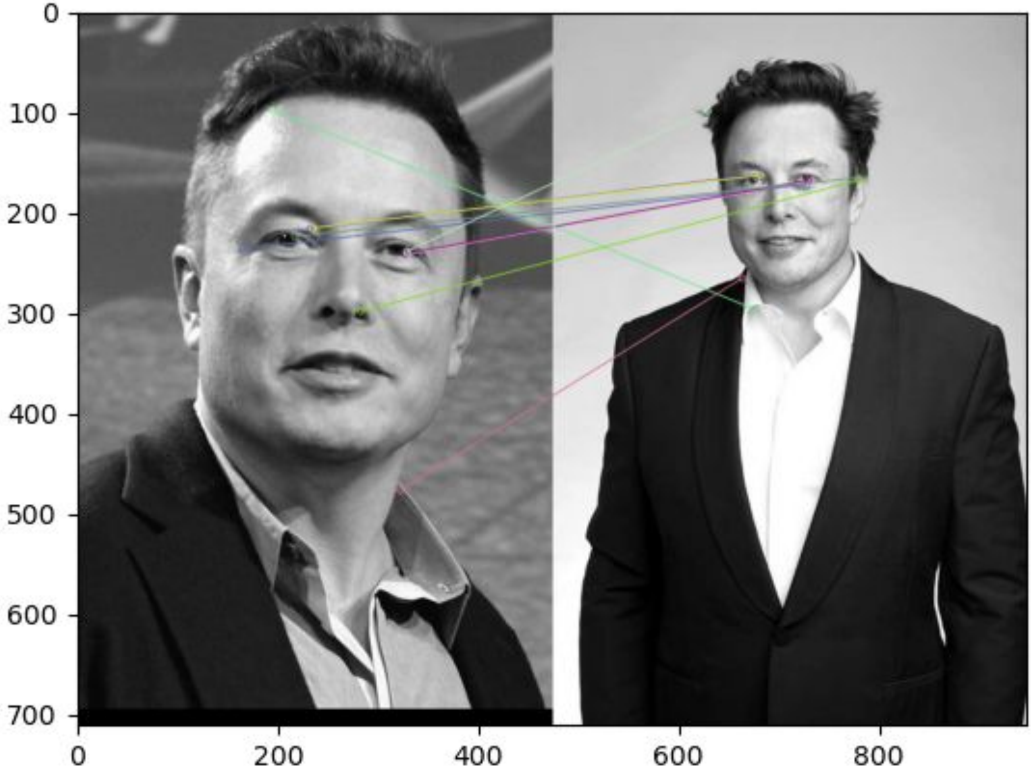
For this, we will use the ORB Descriptors.

This will return the similar parts from two images and arrange them in increasing order of norm.

It is thus stored in decreasing order of similarity. You can choose to find first “M” similar features from the image.

Output-1

Feature comparison of two images using norm

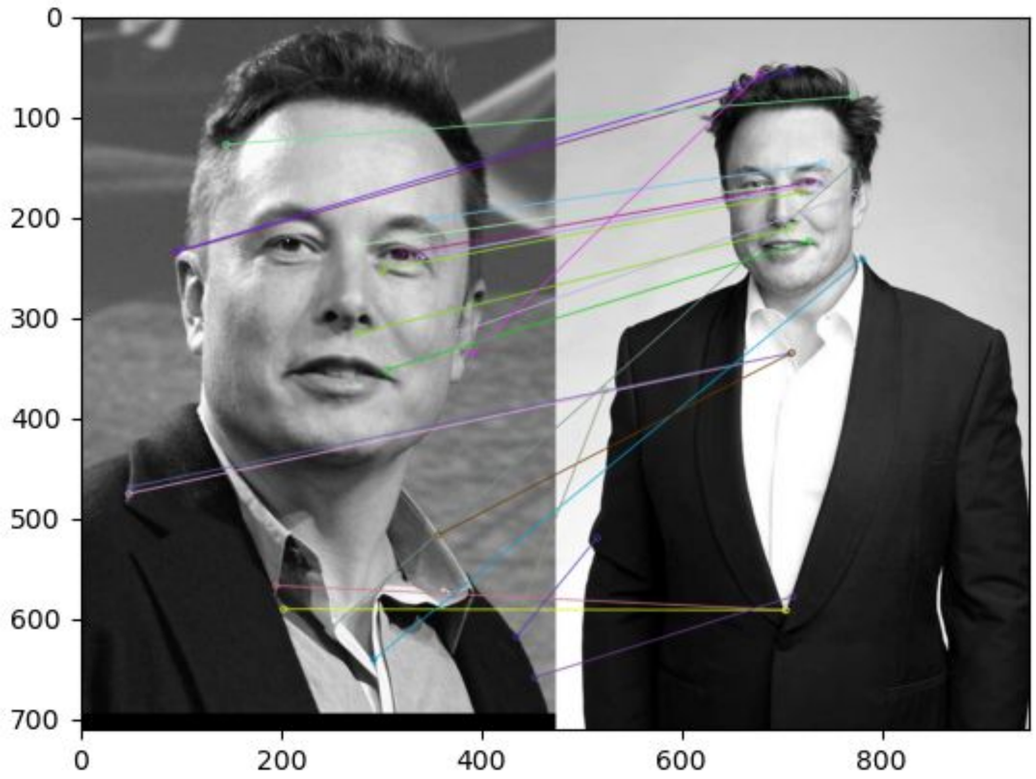


Comparison-2

Another way is to use the Brute Force Matcher to get k best matches.

It uses SIFT Descriptors and machine learning to do feature comparison.

Output-2



Feature comparison of two images using BF Matcher.

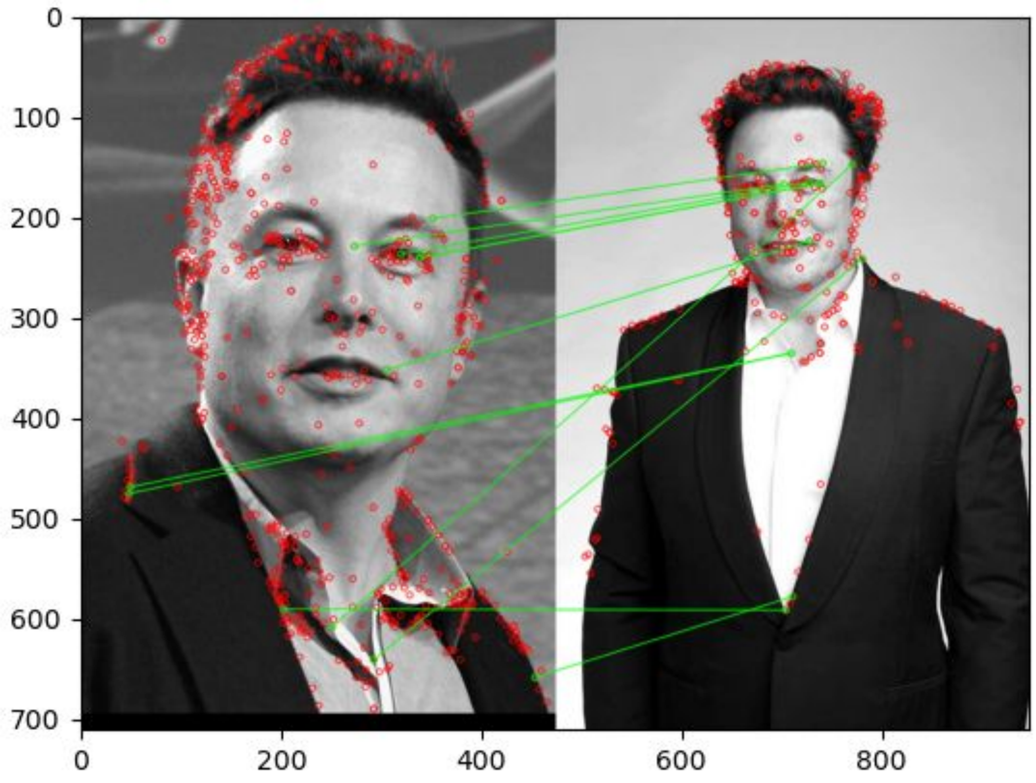
Comparison-3

Another way is to use the FLANN based matcher.

FLANN stands for Fast Library for Approximate Nearest Neighbours. For large datasets and for higher dimensions, it works better than BF Matcher.

Output-3

Feature comparison of two images using FLANN matcher.

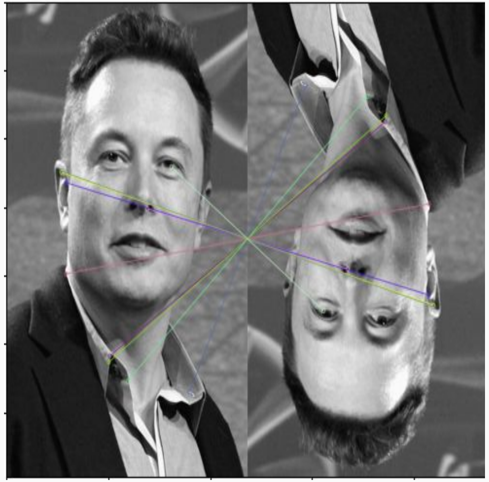


Key features of the comparison algorithm

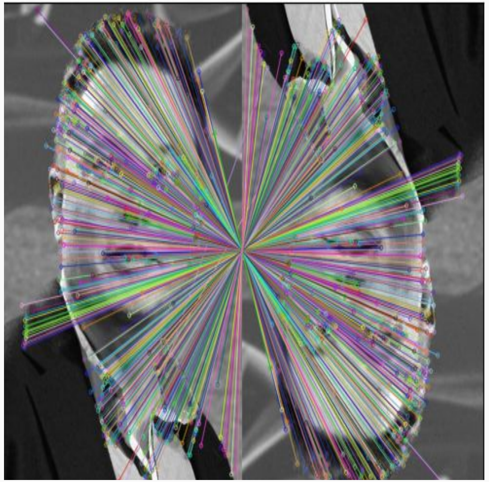
Some of the main features are:

- The algorithm is fast and takes <1 sec/image.
- The algorithm is able to take into consideration the rotations and alignment of view.
- The algorithm compares the features and 2 out of 3 algorithms can be given a mathematical quantity for the similarity extent.

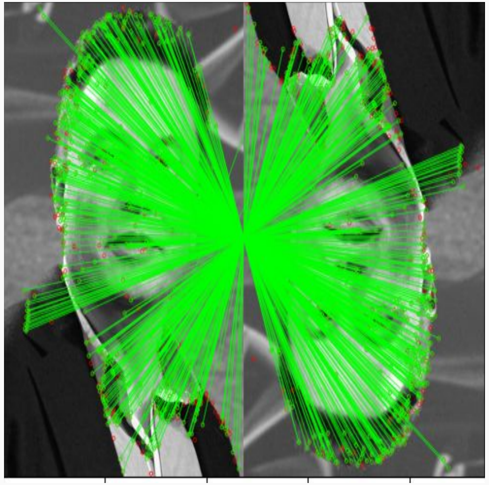
Output with rotated but same image



Algorithm-1

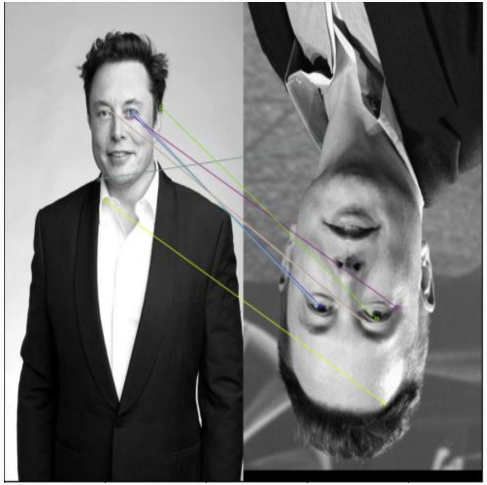


Algorithm-2

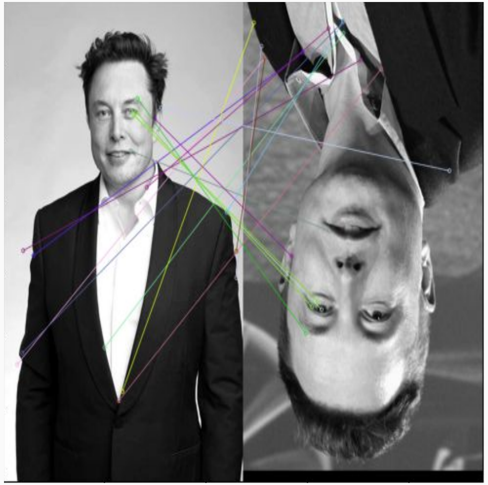


Algorithm-3

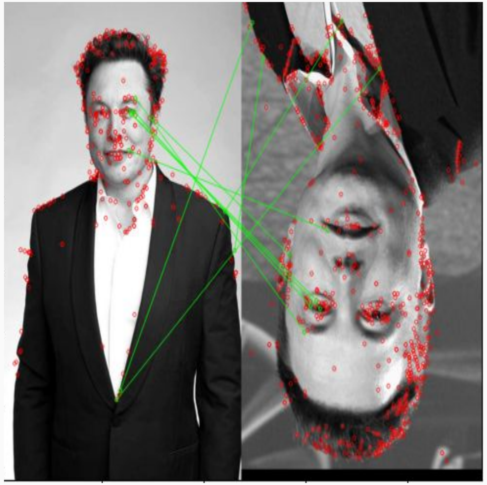
Output with rotated and different image



Algorithm-1



Algorithm-2



Algorithm-3

References

- Research paper on FLANN Algorithm: https://www.researchgate.net/publication/339170738_FLANN_Based_Matching_with_SIFT_Descriptors_for_Drowsy_Features_Extraction
- Comparison of various feature detection algorithms: https://www.researchgate.net/publication/312634655_Comparison_of_OpenCV's_feature_detectors_and_feature_matchers
- https://www.researchgate.net/publication/292995470_Image_Features_Detection_Description_and_Matching