DATA – Grayscale Images of 15 different subjects under 10 different conditions are obtained.
TASK – Obtain only one representative image of each subject for future automated facial recognition purposes.

ALGORITHM:
STEP_1 :
Each grayscale image is of the size 64 x 64 with pixel value in between 0 (minimum) and 255 (maximum). All the images were normalised before applying further methods to reduce the scale in between 0 to 1. This was done by:

$$\mathbf{IMAGE = IMAGE / 255.0.}$$

STEP_2:
For each subject and under each one of 10 different conditions (10 images) the image was transformed using singular value decompositon (SVD):

$$\mathbf{IMAGE = U \Sigma V^T}$$

where columns of **U** contains eigen vectors of (**IMAGE** x $\mathbf{IMAGE^T}$), $\mathbf{\Sigma}$ is the diagonal matrix with eigen values and columns of $\mathbf{V^T}$ contains eigen vectors of ($\mathbf{IMAGE^T}$ x **IMAGE**).
The above equation is further reduced to:

$$\mathbf{IMAGE = u_1\sigma_1v_1^T + u_2\sigma_2v_2^T + u_3\sigma_3v_3^T + ... + ... + u_{n-1}\sigma_{n-1}v_{n-1}^T + u_n\sigma_nv_n^T}$$

The Image is further decomposed by choosing top singular values(x) and corresponding eigen vectors :

$$\mathbf{IMAGE_{svd} = u_1\sigma_1v_1^T + u_2\sigma_2v_2^T + u_3\sigma_3v_3^T + ... u_X\sigma_Xv_X^T \quad where\ x \le n}$$

Here x is top singular values and n=64 is total eigen values.

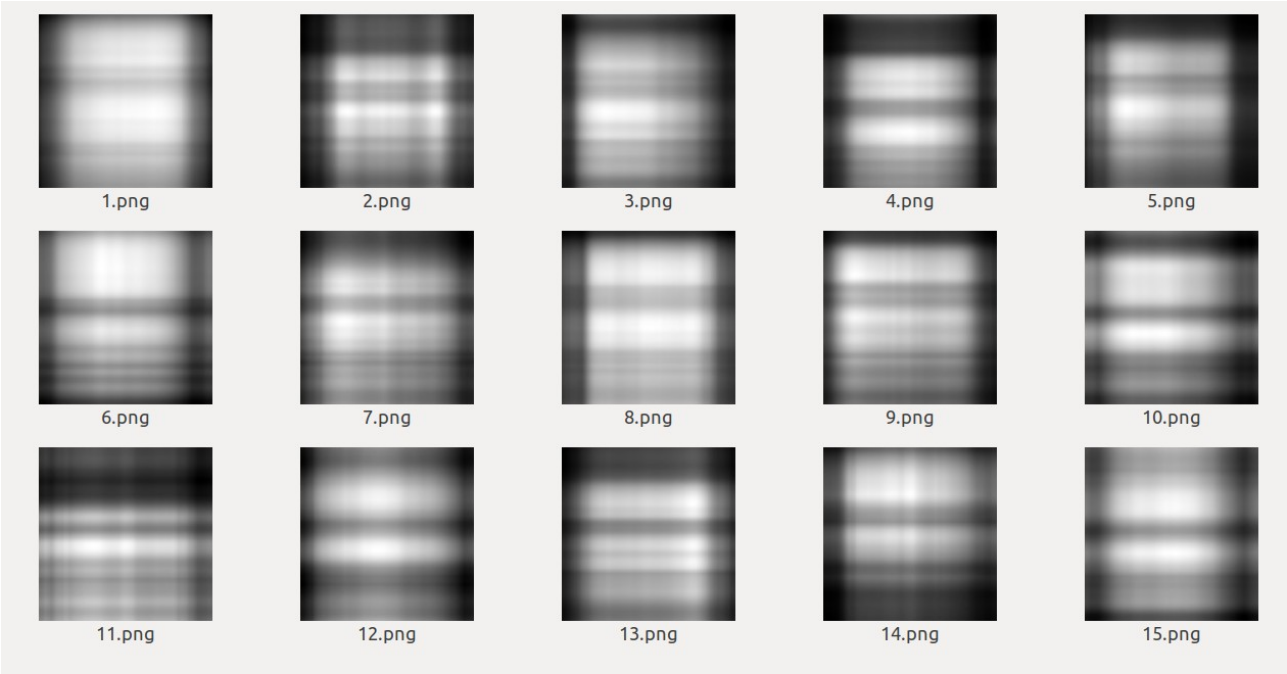
The final representative image for each subject is the average of these 10 different conditions.

$$\mathbf{FINAL\_REPRES\_IMAGE_{SUBJECT} = \left[(IMAGE_{svd})^1 + (IMAGE_{svd})^2 + ... + (IMAGE_{svd})^{10} \right] / 10.0}$$

STEP_3:
The final representative images of all 15 different subjects with different top singular value decomposition is saved. To identify facial detection each of the 150 (15 subject * 10 conditions) images in the given dataset is compared with each of the 15 representative images based on the smallest norm. The norms chosen are L1 and L2 norms although the results with both are the same with experimentation.

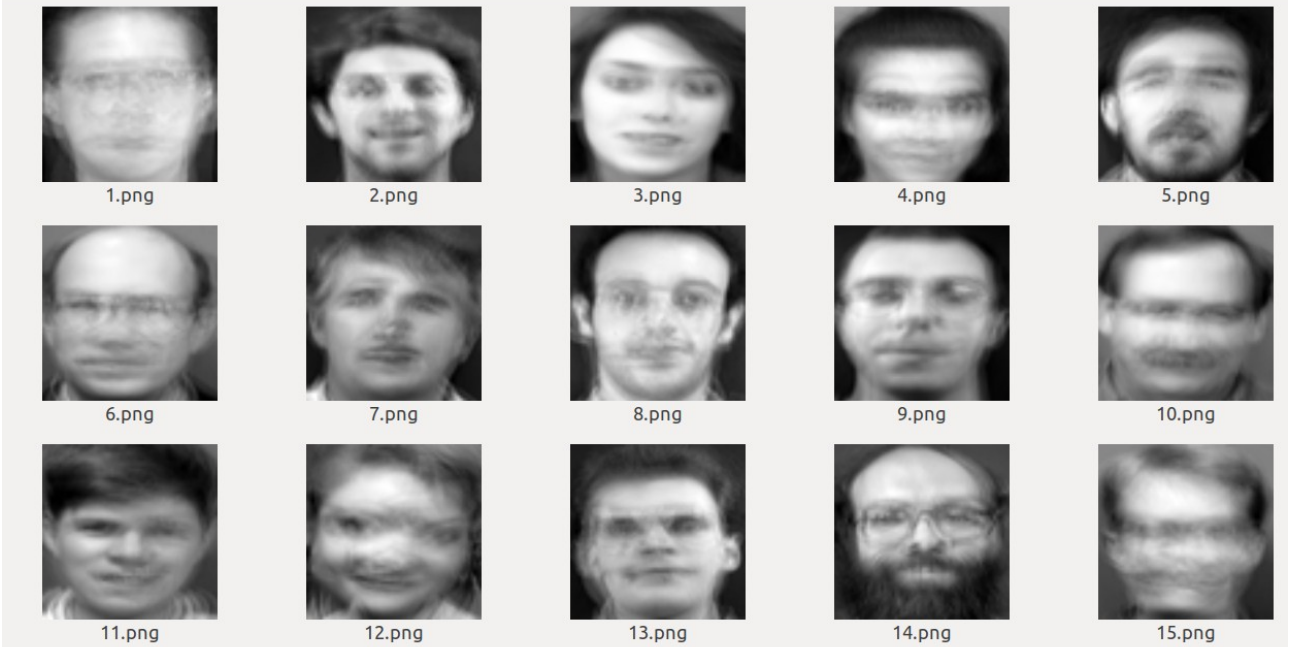
RESULTS:

Sr. No	Number of Top Singular Values (x)	Accuracy %	Number of correctly classified images (of 150)
1	1	96.667	145
2	3	97.333	146
3	4	98.0	147
4	5	98.667	148
5	6	99.333	149
6	64	99.333	149



TOP SINGULAR VALUES = 1

TOP SINGULAR VALUES = 3



TOP SINGULAR VALUES = 64