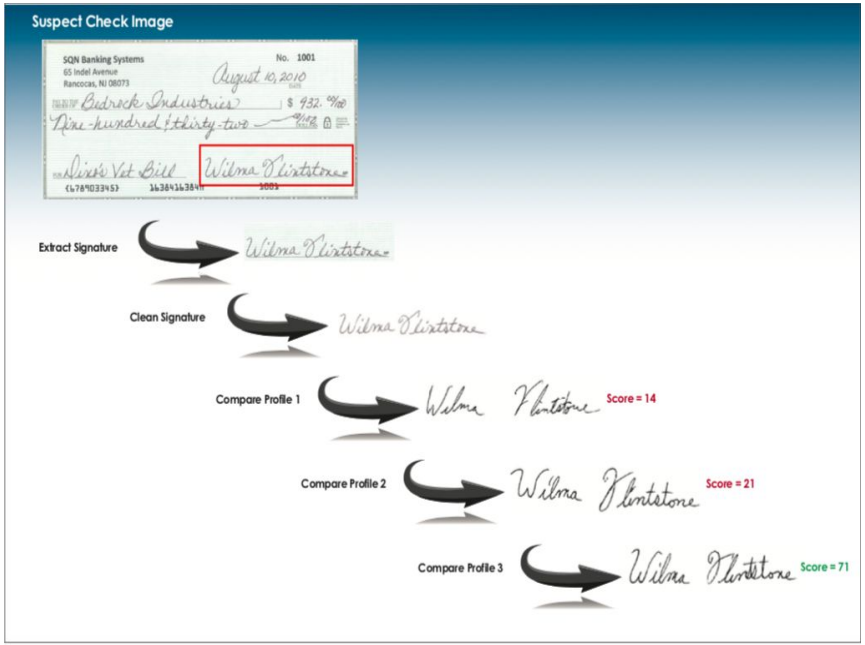
CSP 502
Computer Vision Project

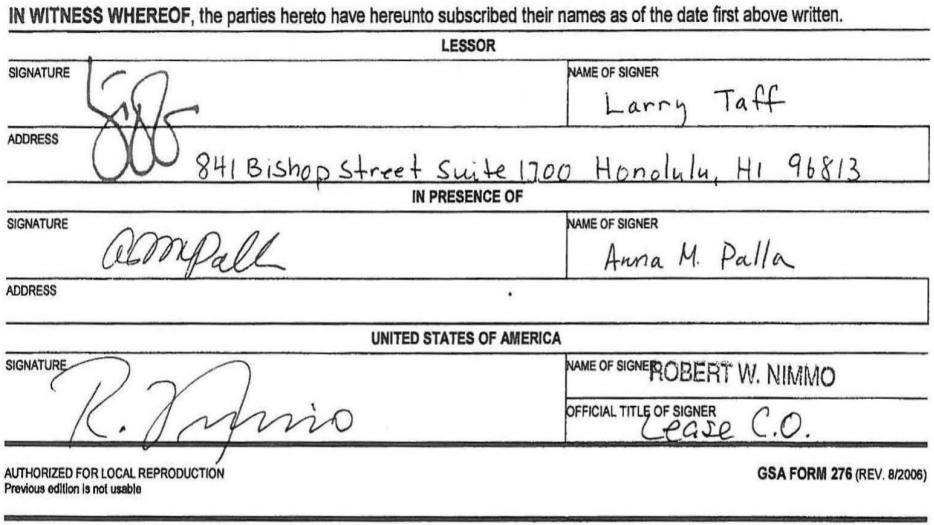
Signature Detection and Verification on Bank Cheques

Group 6
Chintan Gandhi (201501019)
Anshul Jethvani (201501037)
Jay Modi (201501059)
Darshan Shah (201501094)
Harsh Shah (201501096)
Hardik Udeshi (201501113)

Problem Statement

- Detecting signature, localizing signature, cropping the signature and verifying the authenticity of the signature in cheques.

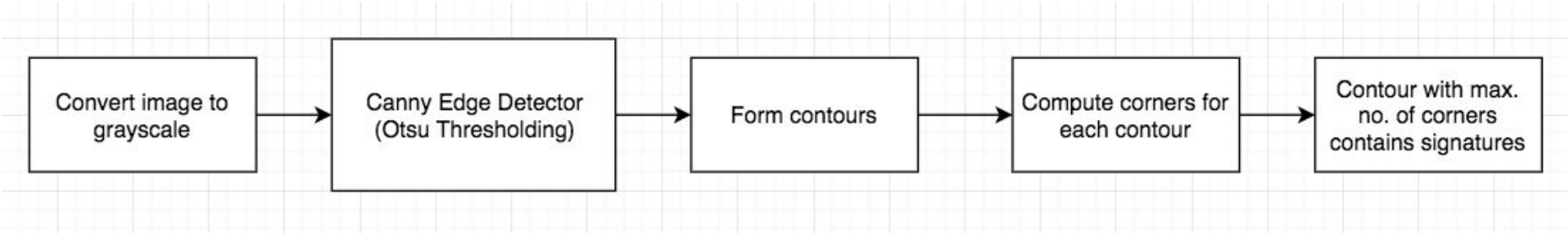




Signature Detection approaches

Approach - 1: Contour features based

- Using edge detection, contours and corners

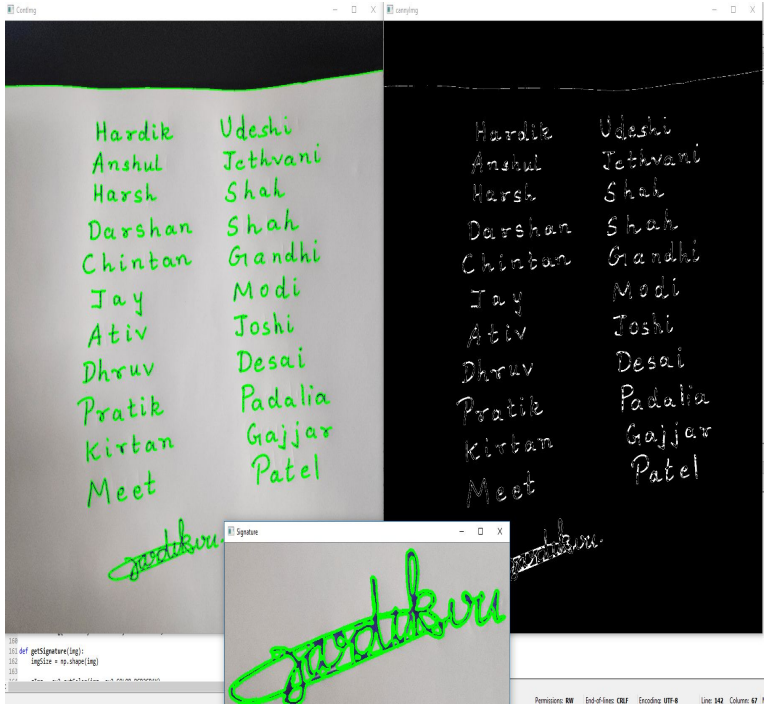


Assumptions:

- Cursive handwriting not used except in signature.
- Signature is connected completely.

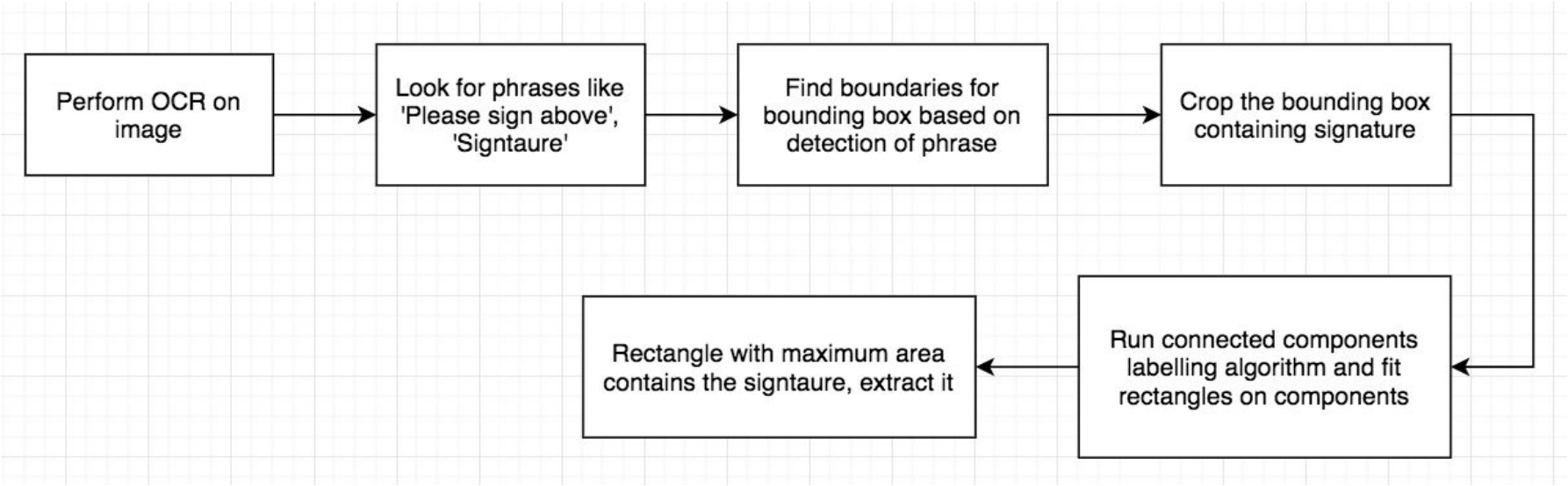
Results

Detected



Failure scenario

Approach - 2: OCR with connected components labelling [1]

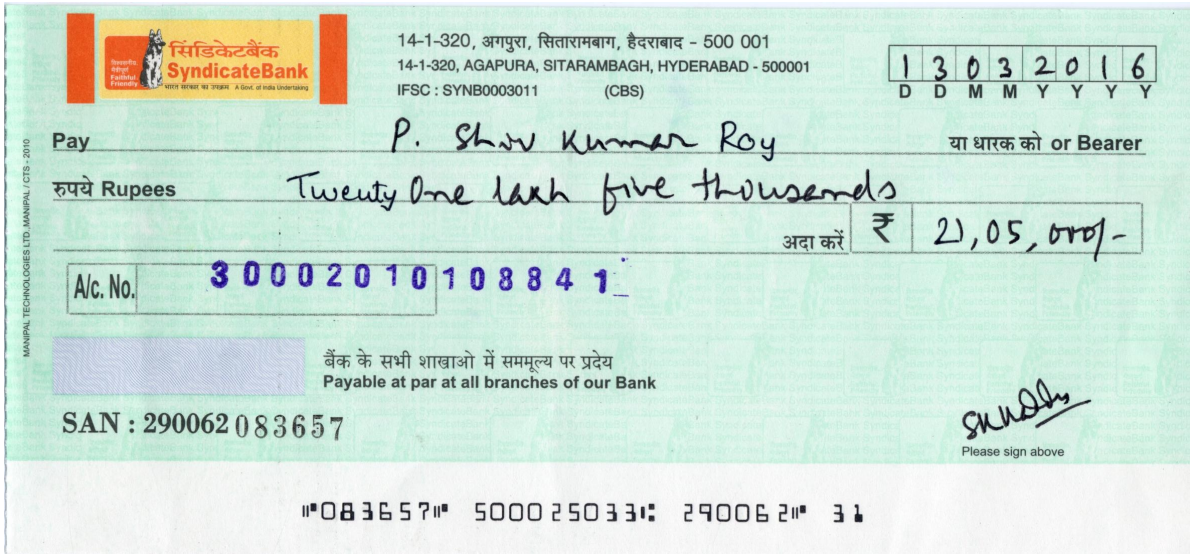


Assumptions:

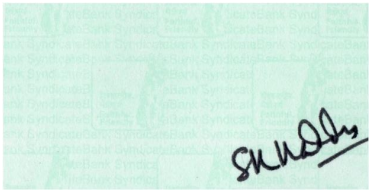
- Cheques contain phrases such as ‘Please sign above’, ‘Signature’, etc.
- Signatures are well connected.

[1] Cüceloğlu, İ., Oğul, H.: Detecting handwritten signatures in scanned documents. Proceedings of the 19th Computer Vision Winter Workshop, pp. 89–94 (2014)

Approach - 2 Cont'd … [2]



Cheque with a phrase “Please Sign Above”

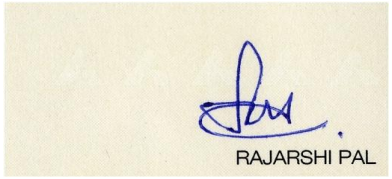


Cropped signature using OCR approach

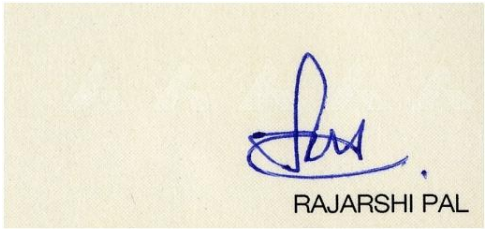
[2] IDRBT Cheque Image Dataset [http://www.idrbt.ac.in/icid.html]

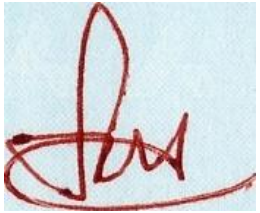
Approach - 2: Results

- Cropped image from OCR alone does not properly extract signatures. The cropped image may contain not useful information.



- After OCR, run connected component labelling algorithm to get a nice extraction of the signature.





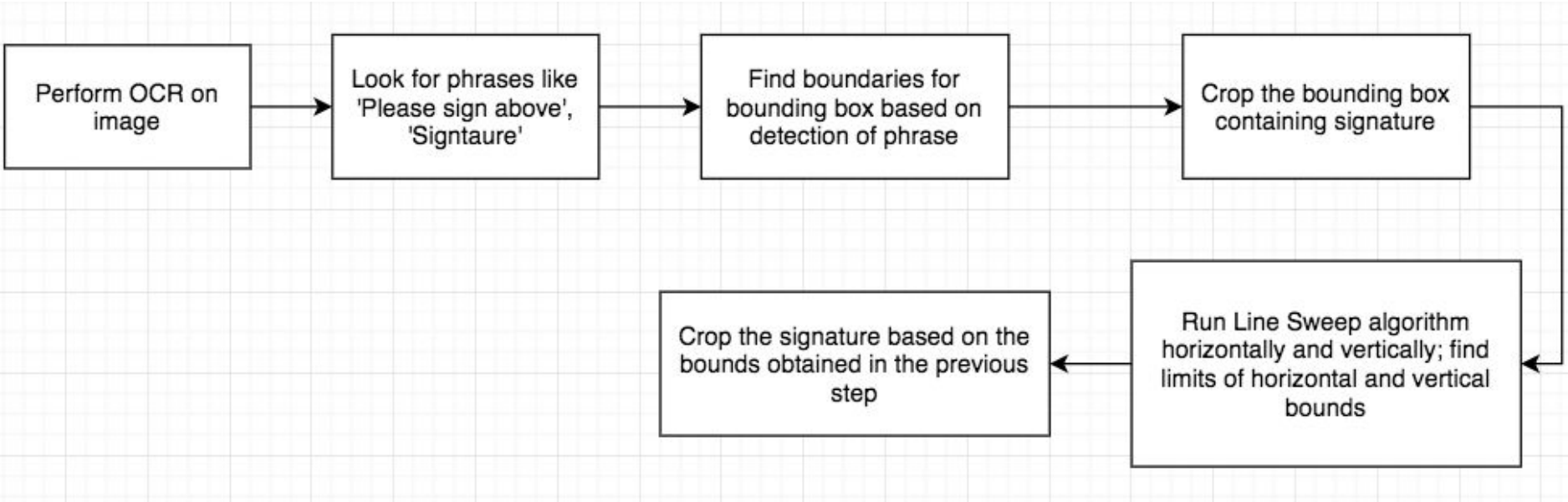
Approach - 2: Failure scenario

- When the components in signature are not connected. Complete signature will not be detected.

Unconnected Signature

Detected incomplete Signature

Approach - 3: OCR with Line Sweep algorithm

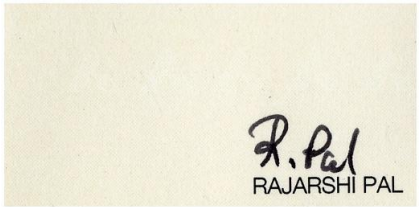


Assumptions:

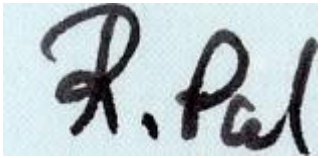
- Cheques contain phrases such as ‘Please sign above’, ‘Signature’, etc.
- The signature components should not be too separated otherwise it may be excluded from the cropping.

Approach - 3: Results

- The algorithm properly removes the text information from cropped image after OCR.
- It is also more robust than connected component approach. Works even when signatures are not connected.



Cropped image after OCR



Cropped image after Line Sweep

Approach - 3: Failure scenario

- This approach fails when signature components are vertically separated

- The assumption made in this approach is reasonable. We feel that this approach is the most practical compared to the other approaches.

Signature verification approaches

Assignment 2

Offline Signature verification using SVM and ANN approach

Abstract

- We attempt to replicate the results of paper [3]:

  "Offline signature recognition using neural networks approach." - Karouni, Ali, Bassam Daya, and Samia Bahlak

- We incorporate additional features like convex hull area, contour area, aspect ratio, bounding rectangle area, etc. for better characterization of signatures.

- We use two classifiers: SVM and ANN and compare the results.

[3] Karouni, Ali, Bassam Daya, and Samia Bahlak. "Offline signature recognition using neural networks approach." Procedia Computer Science 3 (2011): 155-161.

Pre-processing & Feature extraction [3,4]

- The cropped images after OCR or contour approach is converted to grayscale and then binarization is performed on the image to remove background noise and emphasize the signature to be verified.

- **Centroid:** Horizontal and vertical centres of signature region.
- **Eccentricity:** The ratio of the distance between the foci of the ellipse and its major axis length.
- **Solidity:** The Ratio of pixels in the region to pixels of the convex hull image.
- **Kurtosis:** It is a measure of flatness of distribution. High kurtosis denotes low noise.

[3] Karouni, Ali, Bassam Daya, and Samia Bahlak. "Offline signature recognition using neural networks approach." Procedia Computer Science 3 (2011): 155-161.
[4] Chandra, Subhash, and Sushila Maheskar. "Offline signature verification based on geometric feature extraction using artificial neural network." In Recent Advances in Information Technology (RAIT), 2016 3rd International Conference on, pp. 410-414. IEEE, 2016.

- **Skewness:** Measure of asymmetry of distribution. Hazy and smooth surfaces are more positively skewed.
- **Contour area:** Area of the contour formed around the signature region.
- **Convex hull area:** Area of tightly bounded region of the signature.
- **Aspect ratio:** Ratio of width and height of signature images.
- **Bounding rectangle area:** Area of the rectangle formed around the signature region; product of width and height in calculating aspect ratio.
- **SIFT Features:** To make up for the rotation and translation of signature present in image region.

Results

Binary Image of the Genuine Signature

Boundary Box of the Genuine Signature

Convex Hull of the Genuine Signature

Contour formation around the Genuine Signature

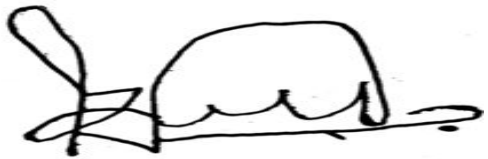

anshul@anshul: ~/Desktop/cv/verification/Signature-Verification
File Edit View Search Terminal Help
anshul@anshul:~/Desktop/cv/verification/Signature-Verification$ python nn.py
Enter person's id : 011
Enter path of signature image : forged_11.png
2018-10-30 22:57:43.040541: I tensorflow/core/platform/cpu_feature_guard.cc:140] Your CPU supports instructions that this TensorFlow binary was not compiled to use: AVX2 FMA
Forged Image
anshul@anshul:~/Desktop/cv/verification/Signature-Verification$


anshul@anshul: ~/Desktop/cv/verification/Signature-Verification
File Edit View Search Terminal Help
anshul@anshul:~/Desktop/cv/verification/Signature-Verification$ python nn.py
Enter person's id : 011
Enter path of signature image : genuine_11.png
2018-10-30 22:48:23.369745: I tensorflow/core/platform/cpu_feature_guard.cc:140] Your CPU supports instructions that this TensorFlow binary was not compiled to use: AVX2 FMA
Genuine Image
anshul@anshul:~/Desktop/cv/verification/Signature-Verification$

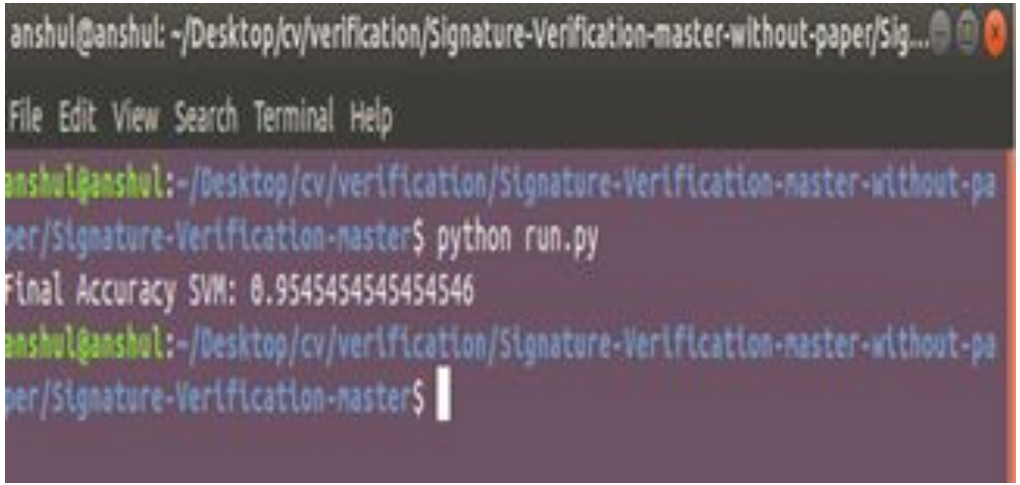
- We implemented SVM and ANN classification approaches on our own dataset of cheques.

Genuine

Forged



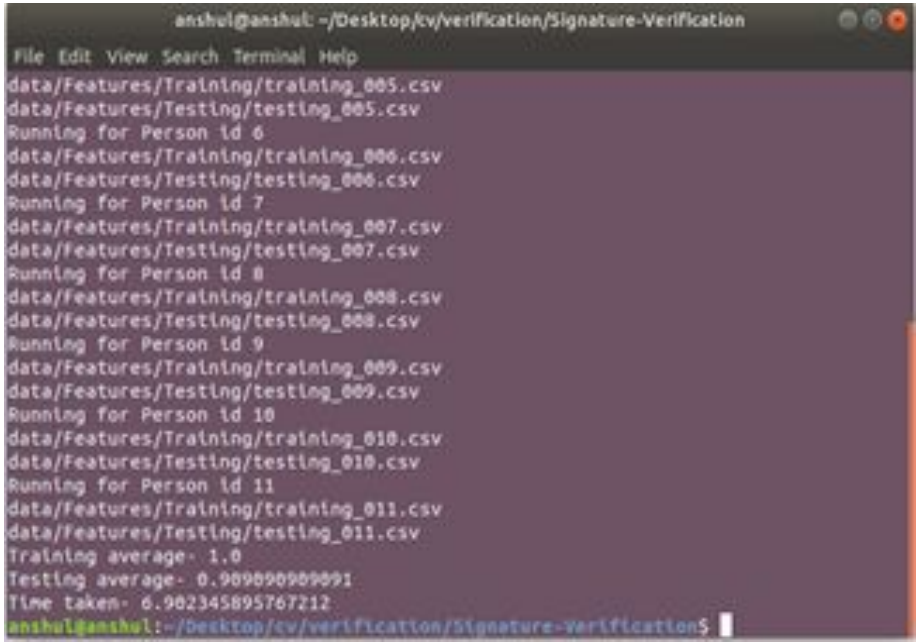
Results: SVM with SIFT (11 distinct signatures)



SVM Final Accuracy (with SIFT): 95.45%

Result: ANN with SIFT features (11 distinct signatures)

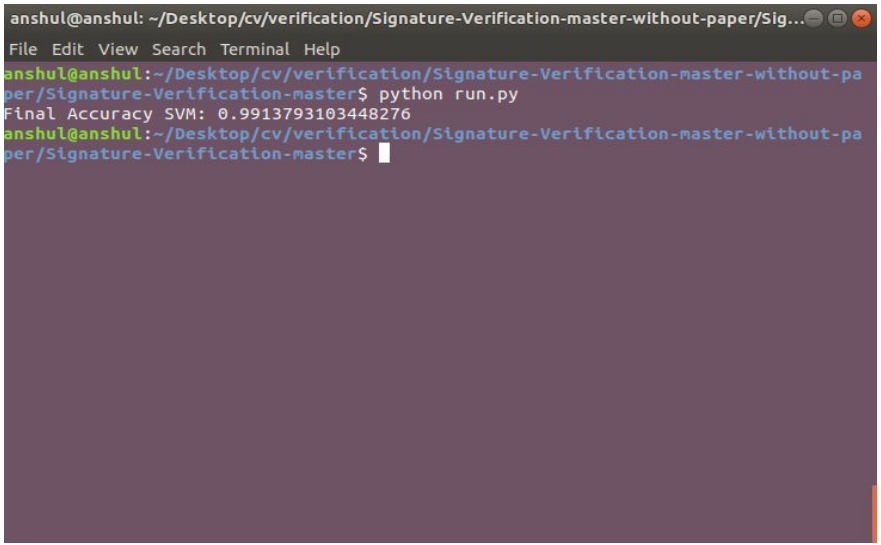
- ANN classifier: 3 layer neural net - input layer, 7 neuron hidden layer, 1 neuron output layer
- Outputs 1 if the signature is genuine or forged
- For the test dataset, genuine and forged signatures are input to the ANN and the predicted and actual labels are matched to compute the accuracy.



ANN Final Accuracy (with SIFT): 90.9 %

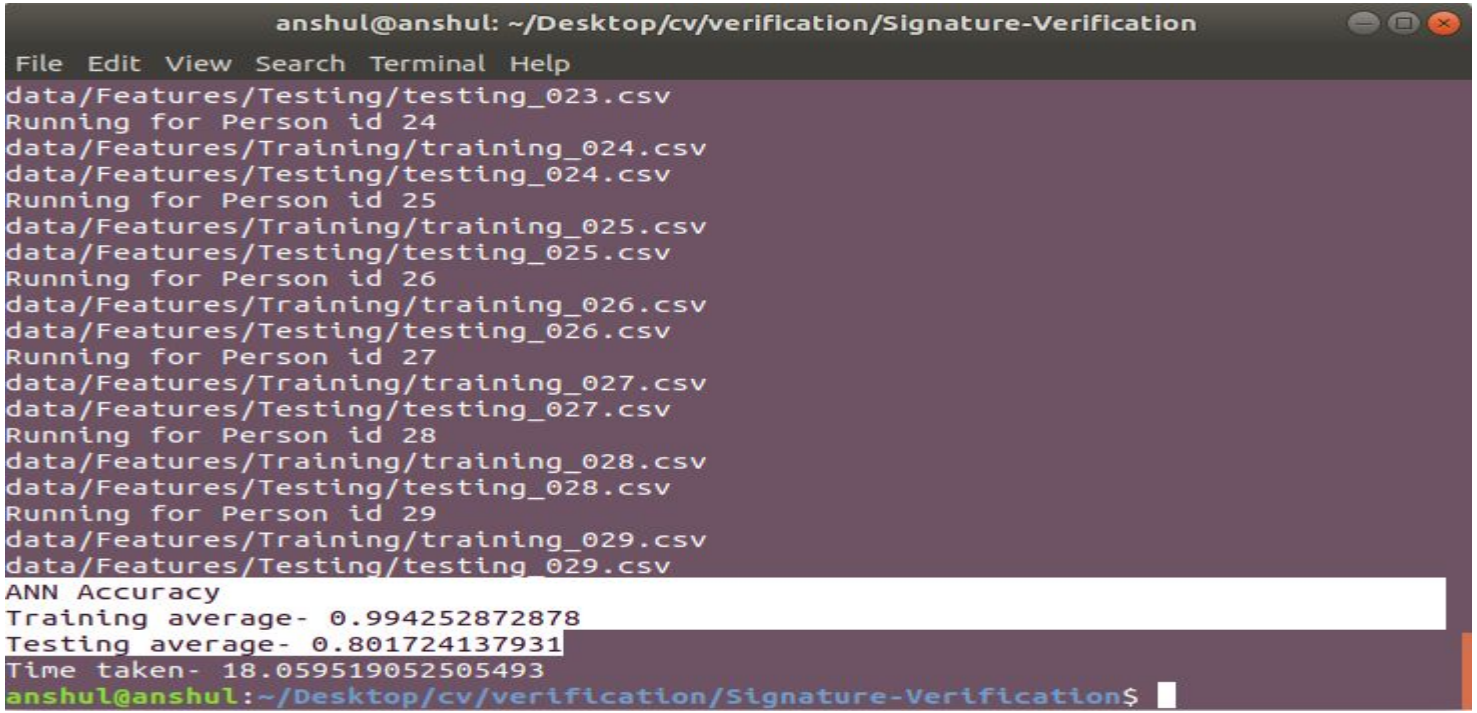
Result: SVM with SIFT (29 distinct signatures)

- SVM based : Feature vector is passed to an SVM with a linear kernel. For the test dataset, genuine and forged signatures are input to the SVM and the predicted and actual labels are matched to compute the accuracy.



SVM Final Accuracy (with SIFT): 99.13%

Result: ANN without SIFT (29 distinct signatures)



ANN final accuracy (without SIFT): 80.17%

Conclusion

- Line-Sweeping algorithm after OCR detection works best for our dataset for exact localization of signatures in cheques.
- SIFT features are extremely important for characterization of signatures because it handles rotated images, shear images and other illumination scenarios.

THANK YOU