References

[1] E. Borovikov, "A survey of modern optical character recognition techniques," *ArXiv Prepr. ArXiv14124183*, 2014.

[2] A. Singh, K. Bacchuwar, and A. Bhasin, "A survey of OCR applications," *Int. J. Mach. Learn. Comput.*, vol. 2, no. 3, p. 314, 2012.

[3] L. V. Rasmussen, P. L. Peissig, C. A. McCarty, and J. Starren, "Development of an optical character recognition pipeline for handwritten form fields from an electronic health record," *J. Am. Med. Inform. Assoc. JAMIA*, vol. 19, no. e1, pp. e90–e95, Jun. 2012.

[4] S. Carbonnel and E. Anquetil, "Lexical post-processing optimization for handwritten word recognition," in *Document Analysis and Recognition, 2003. Proceedings. Seventh International Conference on*, 2003, pp. 477–481.

[5] J. Jin, X. Han, and Q. Wang, "Mathematical Formulas Extraction.," in *ICDAR*, 2003, pp. 1138–1141.

[6] J. R. Bruce, "Mathematical Expression Detection and Segmentation in Document Images," Virginia Tech, 2014.

[7] R. J. Fateman, "How to find mathematics on a scanned page," in *Proc. SPIE*, 1999, vol. 3967, pp. 98–109.

[8] G. Nagy, T. A. Nartker, and S. V. Rice, "Optical character recognition: An illustrated guide to the frontier," in *Electronic Imaging*, 1999, pp. 58–69.

[9] P. M. Kamble and R. S. Hegadi, "Handwritten Marathi Character Recognition Using R-HOG Feature," *Procedia Comput. Sci.*, vol. 45, pp. 266–274, 2015.

[10] A. Choudhary, R. Rishi, and S. Ahlawat, "Off-line Handwritten Character Recognition Using Features Extracted from Binarization Technique," *AASRI Procedia*, vol. 4, pp. 306–312, 2013.

[11] A. Bal and R. Saha, "An Improved Method for Handwritten Document Analysis Using Segmentation, Baseline Recognition and Writing Pressure Detection," *Procedia Comput. Sci.*, vol. 93, pp. 403–415, 2016.

[12] Y.-N. Chang, S. Furber, and S. Welbourne, "Modelling normal and impaired letter recognition: Implications for understanding pure alexic reading," *Neuropsychologia*, vol. 50, no. 12, pp. 2773–2788, Oct. 2012.

[13]   M. Ryan and N. Hanafiah, "An Examination of Character Recognition on ID card using Template Matching Approach," *Procedia Comput. Sci.*, vol. 59, pp. 520–529, Jan. 2015.

[14]   W. A. Barrett and H. E. Nielson, "Consensus-based table form recognition," 2003.

[15]   A. Kornai, C. Scott, and others, "Recognition of cursive writing on personal checks," 1996.

[16]   X. Xiaobing, W. Xiaoxu, W. Jianping, Z. Chenghui, and Q. Yuping, "Recognition Research of Offline-handwritten Chinese Character Based on Biomimetic Pattern," *Procedia Eng.*, vol. 15, pp. 5116–5120, 2011.

[17]   S. Celar, Z. Stojkic, Z. Seremet, Z. Marusic, and D. Zelenika, "Classification of Test Documents Based on Handwritten Student ID's Characteristics," *Procedia Eng.*, vol. 100, pp. 782–790, 2015.

[18]   E. Tapia and R. Rojas, "Recognition of on-line handwritten mathematical expressions using a minimum spanning tree construction and symbol dominance," in *International Workshop on Graphics Recognition*, 2003, pp. 329–340.

[19]   J. F. Pitrelli and M. P. Perrone, "Confidence-scoring post-processing for off-line handwritten-character recognition verification," in *Document Analysis and Recognition, 2003. Proceedings. Seventh International Conference on*, 2003, pp. 278–282.

[20]   I. Bhattacharya, P. Ghosh, and S. Biswas, "Offline Signature Verification Using Pixel Matching Technique," *Procedia Technol.*, vol. 10, pp. 970–977, 2013.

[21]   M. Cheriet, "Shock filters for character image enhancement and peeling," 2003, vol. 1, pp. 1247–1251.

[22]   Y. Zheng, H. Li, and D. Doermann, "Text identification in noisy document images using Markov random model," in *Document Analysis and Recognition, 2003. Proceedings. Seventh International Conference on*, 2003, pp. 599–603.

[23]   M.-C. Jung, Y.-C. Shin, and S. N. Srihari, "Multifont classification using typographical attributes," in *Document Analysis and Recognition, 1999. ICDAR'99. Proceedings of the Fifth International Conference on*, 1999, pp. 353–356.

[24]   A. Kornai, "An experimental HMM-based postal ocr system," in *Acoustics, Speech, and Signal Processing, 1997. ICASSP-97., 1997 IEEE International Conference on*, 1997, vol. 4, pp. 3177–3180.

[25]   M. Mirmehdi, P. Clark, and J. Lam, "Extracting low resolution text with an active camera for OCR," in *Proceedings of the IX Spanish Symposium on Pattern Recognition and Image Processing*, 2001, pp. 43–48.

[26]   T. Abu-Ain, S. N. H. S. Abdullah, B. Bataineh, W. Abu-Ain, and K. Omar, "Text Normalization Framework for Handwritten Cursive Languages by Detection and Straightness the Writing Baseline," *Procedia Technol.*, vol. 11, pp. 666–671, 2013.

[27]   W. Du, "Code Runner: Solution for Recognition and Execution of Handwritten Code."

[28]   M. M. M. Fahmy, "Online handwritten signature verification system based on DWT features extraction and neural network classification," *Ain Shams Eng. J.*, vol. 1, no. 1, pp. 59–70, Sep. 2010.

[29]   S. Malakar, R. K. Das, R. Sarkar, S. Basu, and M. Nasipuri, "Handwritten and Printed Word Identification Using Gray-scale Feature Vector and Decision Tree Classifier," *Procedia Technol.*, vol. 10, pp. 831–839, 2013.

[30]   N. Samadiani and H. Hassanpour, "A neural network-based approach for recognizing multi-font printed English characters," *J. Electr. Syst. Inf. Technol.*, vol. 2, no. 2, pp. 207–218, Sep. 2015.

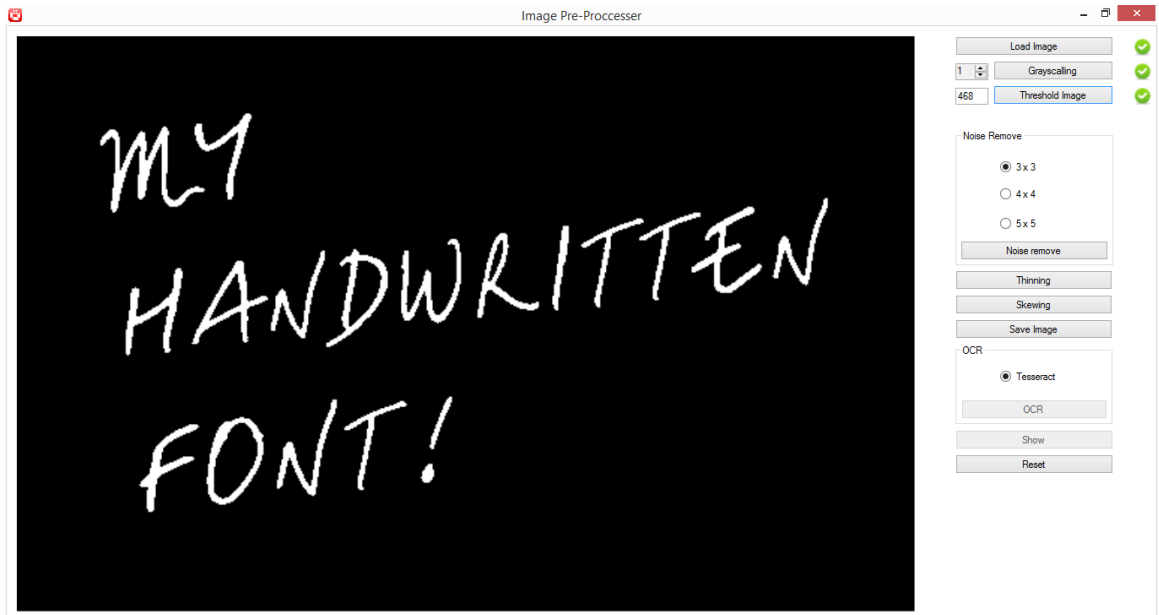[31]   B. Borjigin, "An Overview of the Tesseract OCR Engine."

Appendix

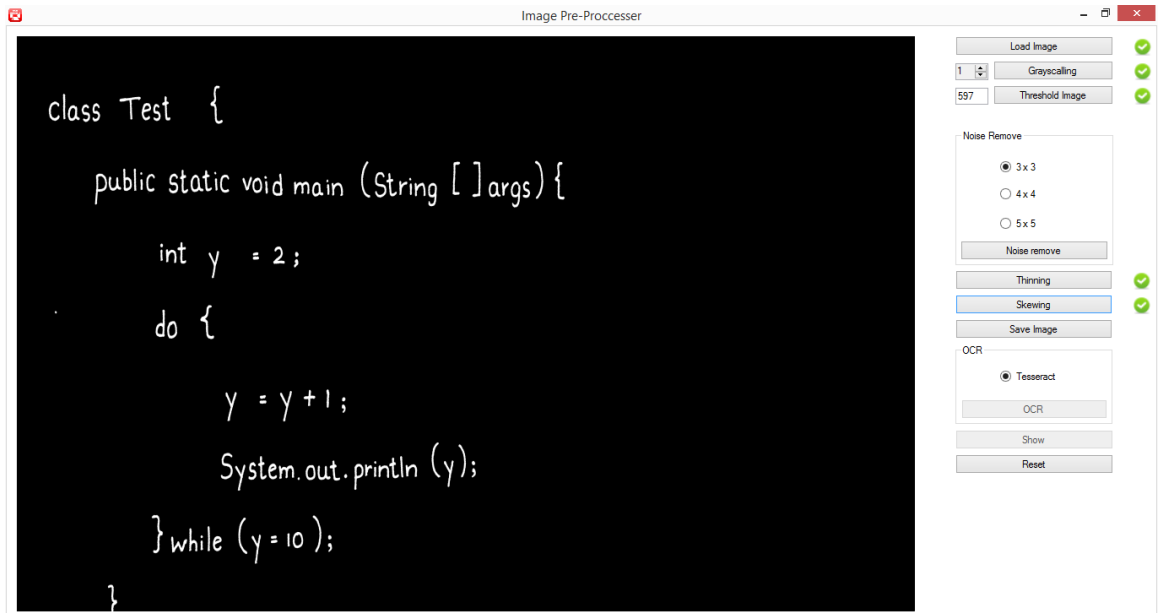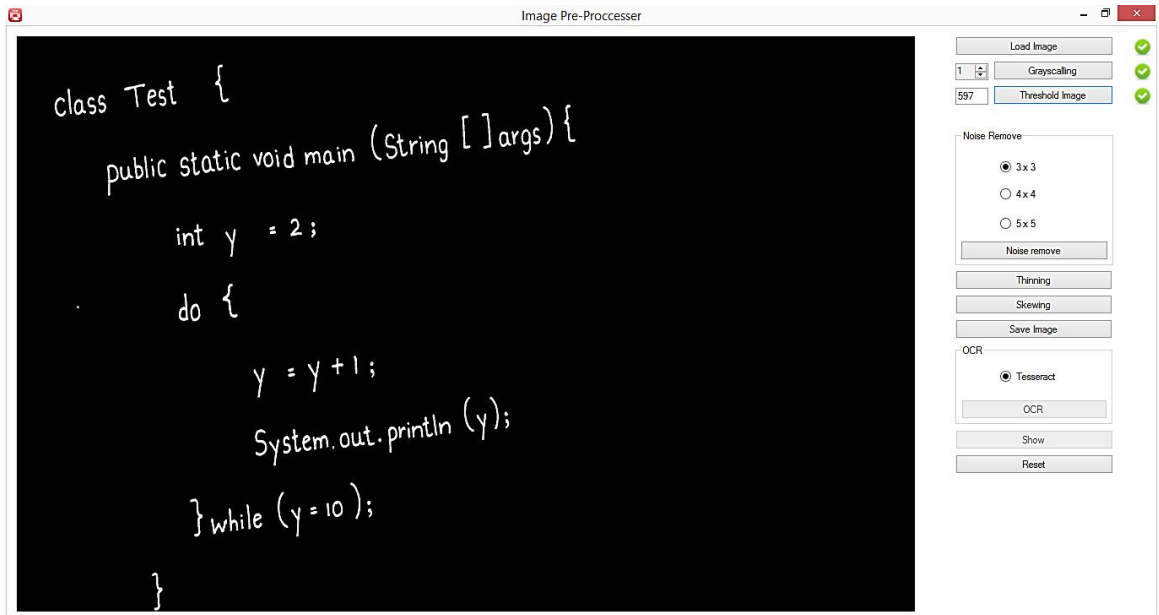*Appendix A - Sample for gray scaled image*
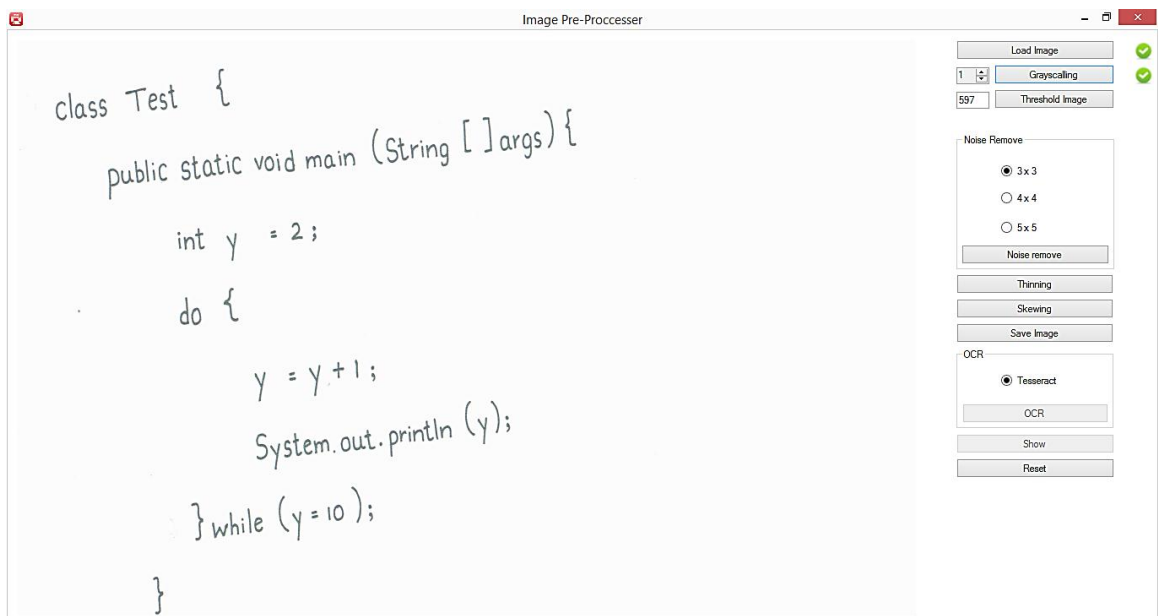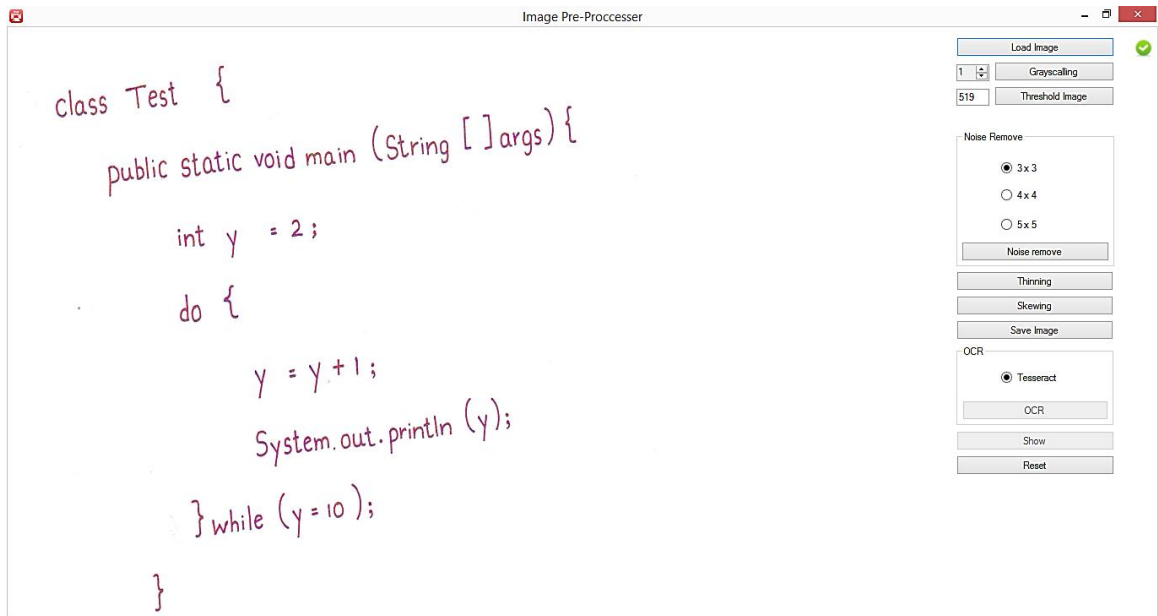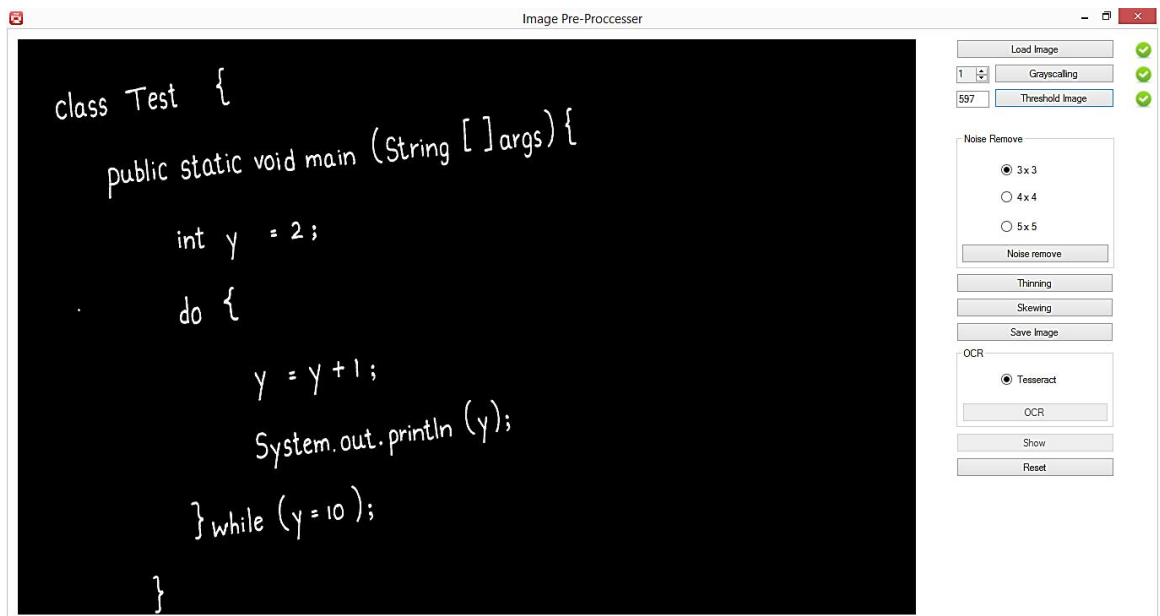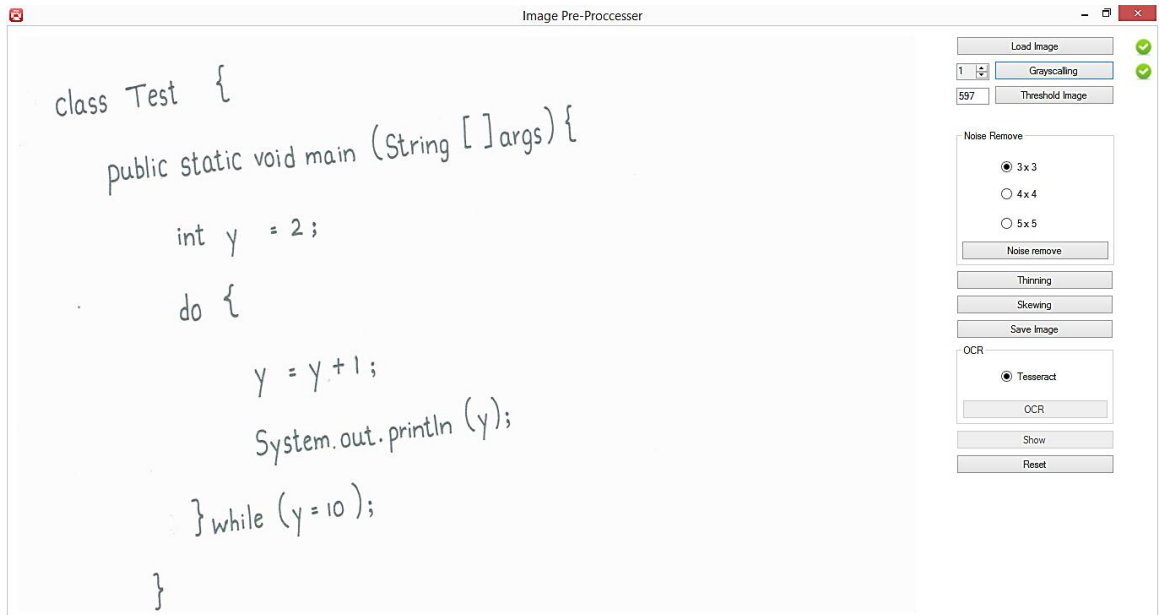
Image	Character count	Before Train				After Train			
		Incorrect Case Sensitivity		Case Sensitive		Incorrect Case Sensitivity		Case Sensitivity	
		Characters	%	Characters	%	Characters	%	Characters	%
1	97	87	89.69	84	86.60	92	94.85	91	93.81
2	102	65	63.73	64	62.75	100	98.04	98	96.08
3	110	92	83.64	86	78.18	105	95.45	103	93.64
4	81	68	83.95	65	80.25	78	96.30	78	96.30
5	187	146	78.07	141	75.40	184	98.40	184	98.40
SUM	577	458	399.08	440	383.17	559	483.03	554	478.22
AVG	115.4	91.6	79.82	88	76.63	111.8	96.61	110.8	95.64