

# Recognition of Handwritten Digits using Machine Learning

**Farande Pallavi Sanjay, Shinde Priti Ramesh, Pachpute Shivani Satish,  
Shinde Sakshi Bhausaheb, Prof. Gunaware N. G**  
Department of Computer Engineering  
HSBPVT'S GOI, College of Engineering, Ahmednagar, Maharashtra, India

**Abstract:** *It is computer technology related to computer vision and image processing. This paper illustrates the application of object character recognition (OCR) using template matching and machine learning techniques. The solution of paper we perform the recognition task using Template Matching, Support Vector Machine (SVM), and Feed Forward Neural Network. Templatematching is an image processing technique to break the image into small parts and then match the other image to a template image. The use a Multi Class SVM classifier and Neural Network to classify the image. The use the dataset to train the classifier followed by feature extraction and finally applying the classifiers to recognize the digits.*

**Keywords:** Vector Machine, Template, Neural Networks, Feature Extraction, TensorFlow, Machine Learning, YOLO.

## REFERENCES

- [1]. F. Bastien, P. Lamblin, R. Pascanu, J. Bergstra, I. J. Goodfellow, A. Bergeron, N. Bouchard, and Y. Bengio. Theano: new features and speed improvements. Deep Learning and Unsupervised Feature Learning NIPS 2012 Workshop, 2012
- [2]. Qiao Tan, Yuanlin Wen, Chenyue Meng Learning of Visualization of Object Recognition Features and Image Reconstruction
- [3]. Žiga Zadnik, Handwritten character Recognition: Training a Simple NN for classification using MATLAB)
- [4]. J. Pradeep, E. Srinivasan, and S. Himavathi, Diagonal Based Feature Extraction For Handwritten Character Recognition System Using Neural Network
- [5]. O. Matan, J. Bromley, C. J. Burges, J. S. Denker, L. D. Jackel, Y. LeCun, E. P. Pednault, W. D. Satterfield, C. E. Stenard, T. J. Thompson, Reading Handwritten Digits: A Zip Code Recognition System
- [6]. C-L. Liu and K. Marukawa, "Normalization Ensemble for Handwritten Character Recognition", The Ninth International Workshop on Frontiers in Handwriting Recognition (IWFHR 9), Tokyo, Japan, pp. 69-74, 2004
- [7]. <https://www.elen.ucl.ac.be/Proceedings/esann/esannpdf/es1999-461>
- [8]. Vanderbrug, G.J, Rosenfeld, —Two-Stage Template Matching, IEEE Transactions on Computers, Vol. 60, Issue 11, 1977
- [9]. P. Weinzaepfel, H. Jegou, and P. Perez. Reconstructing an image from its local descriptors. In Computer Vision and Pattern Recognition, 2011, pages 337 – 344. IEEE.
- [10]. [D. M. Zeiler and R. Fergus. Visualizing and understanding convolutional networks. In Computer Vision and Pattern Recognition, 2013.
- [11]. M. Zeiler and R. Fergus. Visualizing and understanding convolutional networks. In arXiv:1311.2901, 2013.
- [12]. M. D. Zeiler and R. Fergus. Visualizing and understanding convolutional networks. In Computer Vision