**A Novel Method for Handwritten Digit Recognition System**

**Domain**: Artificial Intelligence

**Batch No**: B2-2M4E

**Team ID**: PNT2022TMID46059

**Team Members**: Shafeena Begum M S

Yazhini P

Preethi K

Ragavi G

**Paper 1**: Pre-processing techniques involved in the character recognition

# Publication Year: 2013

**Author**: K. Gaurav, Bhatia P. K

Handwritten character recognition (HCR) is the process of conversion of handwritten text into machine readable form. The major problem in HCR system is the variation of the handwriting styles, which can be completely different for different writers. In this, different preprocessing techniques like Skew detection and correction, image enhancement techniques of contrast stretching, binarization, noise removal techniques, Normalization and segmentation, morphological processing techniques are discussed. It was concluded that using a single technique for preprocessing, we can’t completely process the Image. However, even after applying all the said techniques might not possible to achieve the full accuracy in a Preprocessing system.

**Paper 2**: Improving Offline Handwritten Text Recognition with Hybrid HMM/ANN Model

# Publication Year: 2011

**Author**: Salvador Espana-Boquera

In this paper, Hybrid HMM/ANN models compute the emission probabilities for the HMMs with a neural network instead of the commonly used Gaussian mixtures. This work is the first successful attempt, to the best of our knowledge, to use hybrid HMM/ANN models in unconstrained offline handwritten text recognition. In this, the structural part of the optical model has been modelled with Markov chains, and a Multilayer Perceptron is used to estimate the emission probabilities. In this paper, different techniques are applied to remove slope and slant from handwritten text and to normalize the size of text images with supervised learning methods. The key features of this recognition system were to develop a system having high accuracy in preprocessing and recognition, which are both based on resulting in scaled likelihoods which are used as emission probabilities in the HMMs.

**Paper 3**: Optimizing Feature Selection for Recognizing Handwritten Arabic Characters

# Publication Year: 2005

**Author**: Mohammed Z. Khedher, Gheith A. Abandah, and Ahmed M. Al Khawaldeh

This paper describes that Recognition is the process of evaluating the extracted features of an unknown character and comparing them with the features of the set of possible characters. An off-line recognition system based on the selected features was built. The system was trained and tested with realistic samples of handwritten Arabic characters. Feature Extraction is the next stage. Extracted features should contain the useful information carried by the character image. The complexity of the handwritten cursive Arabic text requires using many features to make recognition possible. The recognition based on the selected features give average accuracies of 88% and 70% for the numbers and letters, respectively. Further improvements are achieved by using feature weights based on insights gained from the accuracies of individual features.

**Paper 4**: Fuzzy-Zoning-Based Classification for Handwritten Characters

# Publication Year: 2011

**Author**: G. Pirlo and D. Impedovo

This paper introduces a new class of fuzzy-membership functions

(FMFs) and presents a real-coded genetic algorithm to detect, in a

single optimization procedure, the optimal FMF, together with the optimal zoning, for the specific classification problem. In this research, a real coded genetic algorithm is presented to find, in a single optimization procedure, the optimal FMF, together with the optimal zoning described by Voronoi tessellation. The experimental results, which are carried out in the field of handwritten digit and character recognition, indicate that optimal FMF performs better than other membership functions based on abstract level, ranked-level, and measurement level weighting models, which can be found in the literature. Additionally, they confirm the effectiveness of the genetic technique for the combine selection of the optimal zoning and optimal FMF.

**Paper 5**: Feature Selection Using Genetic Algorithm

# Publication Year: 2018

**Author**: Yoshimasa Kimura

This paper presented a work on how to select features for Character Recognition Using Genetic Algorithm. Genetic Algorithms aim to replicate the behavior of genetic evolution, whereby the genetics of the individuals best suited to the environment persist over time. The author proposes a novel method of feature selection for character recognition using genetic algorithms (GA). The proposed method selects only the genes for which the recognition rate of training samples exceeds than the predetermined threshold as a candidate of the parent gene and adopts a reduction ratio in the number of features used for recognition as the fitness value.