



A SURVEY ON HANDWRITTEN RECOGNITION USING DIVERSE STRATEGIES

K.NITHYA¹, M.SARANYA²

Assistant Professor, CSE, Nandha College of Technology, Erode, India.

Assistant Professor, CSE, Nandha College of Technology, Erode, India.

Abstract

The survey focuses an entire evaluation of handwritten person recognition (HCR) and its techniques. The handwritten character, reputation has been applied in a variety of programs like Banking sectors, fitness care industries and plenty of such groups where handwritten documents are treated. Handwritten man or woman popularity is the technique of conversion of handwritten text into gadget readable shape. For handwritten characters there are problems love it differs from one creator to any other, even when the same individual writes equal person, there's difference in shape, size and function of character. Brand new research on this area has used extraordinary types of method, classifiers and capabilities to reduce the complexity of recognizing handwritten text.

Introduction

Handwritten person's reputation is a system of transforming handwritten textual content into a machine executable layout. There are mainly three steps in sample popularity: statement, sample segmentation and sample class. Recognition of individual has grown to be a very interesting subject matter in pattern reputation for the researchers throughout the last few decades. In popular, handwritten reputation is classified into 2 sorts as online and stale-line reputation strategies. Off-line handwriting recognition involves the automated conversion of text into a photo into letter codes which are usable inside pc and textual content-processing packages. The statistics acquired by means of this form

are regarded as a static representation of handwriting. But, in the online gadget, the two dimensional coordinates of successive points are represented as a function of time and the order of strokes made by the writer also are to be had. Offline individual reputation is relatively harder because of form of characters, terrific variation of person symbol, unique handwriting style and report first-class.

Several programs which include mail sorting, bank processing, report reading and postal deal with reputation require off-line handwriting recognition systems. As an end result, the off-line handwriting reputation is still an energetic vicinity of research towards exploring the newer techniques that would enhance recognition accuracy.



Advantages and Disadvantages

Handwriting reputation performs a critical position within the storage and retrieval of vital handwritten information DATA garage. Many contracts, files and private information include typed and handwritten statistics. This means that storing such record calls for bodily space due to the fact those unique signatures and notes cannot be electronically stored. The handwriting reputation software program permits users to translate those signatures and notes into digital words. Digital garage of this record requires far much less physical space than the storage of physical copies. Digital garage additionally requires fewer on-hand employees to kind thru, arrange and upkeep the information storage warehouse.

Statistics Retrieval

Physical data retrieval calls for personnel to kind through physical copies of old records. The statistics should have been stored and correctly prepared as well as for the right maintenance and upkeep on the physical copies. You carry out digital statistics retrieval by using the usage of a file seek of precise key phrases, including names or dates. The handwriting reputation software program allows for vintage files to be stored in a proper digital format. Scientific records are greater to be had, two physicians who rely upon antique data to diagnose infection and realize a patient's history. You may evaluation and replace vintage contracts without risking a lack of crucial information because of misspelling or physical facts corruption.

Key phrases

Handwritten person, Preprocessing, Segmentation, feature extraction, type.

STRUCTURE OF A TRENDY HANDWRITTEN POPULARITY SYSTEM

The major steps worried in recognition of characters consist of, preprocessing, segmentation, feature extraction and category.

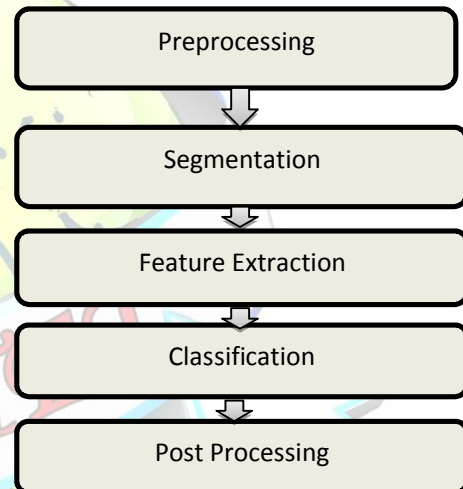
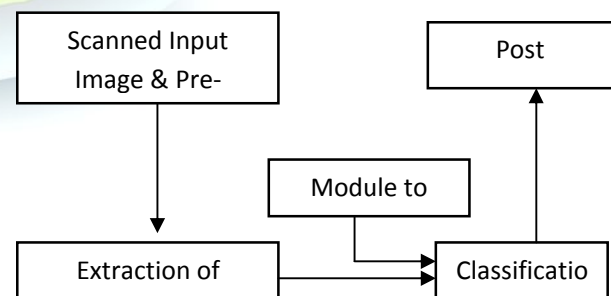


Fig 1 levels of person reputation



Architecture of an individual reputation machine

PRE PROCESSING



Pre-processing can be defined as cleansing the record photo and making it appropriate for enter to the OCR engine. Foremost steps underneath pre-processing are:

- Noise elimination
- Skew detection/correction
- Binarization
- The Noise introduced with the aid

of the optical scanning devices inside the enter results in terrible device performance. These imperfections have to be removed previous to person reputation. Noise may be added in a photograph all through photo acquisition and Transmission. Noise can be of different types as Gaussian noise, Gamma noise, Rayleigh noise, Exponential noise, Uniform noise, Salt and pepper noise, Periodic noise, etc. Noise can be eliminated using ideal filters, Butterworth filters and Gaussian filters. There's a possibility of rotation of photo while scanning. Skew detection and correction is used to align the paper record with the coordinate machine of the scanner. Numerous skew detection techniques are projection profiles, connected components, Hough remodel, clustering and so on. In Binarization, colour or grey-scale photograph is converted into a binary picture with the assist of thresholding. Binary image may be executed the use of Adaptive thresholding, international thresholding, variable thresholding, Ostu's method and so on. Morphological operations are also used in pre-processing. Dilation and Erosion are the morphological operations that boom or decrease the photo size. Erosion makes an

object smaller by way of eroding away the pixels from its edges. Every object pixel that is touching heritage pixels is changed into background Pixel. However, dilation makes an object large by way of adding pixels round its edges. Each pixel that is touching an object pixel is modified into item pixel.

• SEGMENTATION

Segmentation is needed considering the fact that handwritten characters often intervene with one another. Common ways in which characters can intrude consist of: overlapping, touching, related, and intersecting pairs and so forth. For you to separate text from graphs, images, line, text/photographs segmentation are needed. The output has to be a photo which includes text most effective. Character segmentation will separate each man or woman from some other. It's far one of the most important steps in particular in cursive scripts in which characters are related together. The remoted characters received as a result of character segmentation are normalized to a particular size for higher accuracy. Features are extracted from the characters with the equal length with the intention to provide statistics uniformity. Christopher E. Dunn and P. S. P. Wang [5] used a series of location finding, grouping, and splitting algorithms. Vicinity finding will pick out all the disjoint areas. The pixels are in the beginning categorized on/off in which "on" indicates the records regions. Image is tested pixel by means of pixel till "on" cost is observed. Once discovered its miles categorized with new vicinity variety



and its associates are looked for additional “on” value. Seek proceeds till no “on” price is determined. The end result is that each one disjoint regions could be identified and all pixels in any vicinity will be categorized with a completely unique range. Grouping deals with the characters which have separate components or which can be damaged. A smallest bounding container is calculated that absolutely encloses another area. If for any areas the bounding box of 1 location absolutely encloses any other area, then the enclosed region is relabeled to the price of the enclosing region. Thus, the ensuing area is composed of disjoint sub-areas. This is helpful for connecting regions which have been separated because of noise. Splitting [5] offers with touching characters. Anshul Mehta [2] used Heuristic segmentation set of rules which scans the hand written words to perceive the legitimate segmentation points among characters. The segmentation is based totally on locating the arcs among letters, common in handwritten cursive script. For this a histogram of vertical pixel density is tested which may suggest the location of possible segmentation points inside the word. Different individual segmentation methods [4] are Thinning based totally approach, Contour becoming method, robust Statistical approach, speculation Verification, form feature Vector method and so on.

FUNCTION EXTRACTION

FEATURE EXTRACTION

Feature extraction is finding the set of parameters that define the shape of a character exactly and uniquely. Function extraction [3] strategies are categorized into three primary agencies as.

- Statistical functions.
- Worldwide transformation and series growth.
- Geometric and topological functions.

Statistical functions constitute the photo as statistical distribution of factors. Various strategies which use statistical functions are Zoning, Crossings and Distances, Projections and so forth. In worldwide transformation and series enlargement various strategies are Fourier remodel, Gabor transform, Fourier Descriptor, wavelets, moments, Karhunen-Loeve expansion and many others. In Geometric and topological functions, the structural functions like loops, curves, traces, T-point, go, commencing to the right, starting to the left and so forth are used. The numerous classes are coding (freeman chain code), extracting and counting topological structures, graphs and timber. Geometric capabilities are used together with fuzzy logic to understand characters [7]. Adnan Amin [6] and PuttipongMahasukhon [7] used structural facts to extract functions from a man or woman like Breakpoints, Inflection factor, Cusp factor, directly Line, Curve, and Open or close Loop and so forth. Breakpoint divides a direction into sub paths. It has viable situations-Inflection point (change in curvature) and Cusp point



(sharp trade in course).immediately line has factors in sequence in a course. Open curve is as in letter “S”. Closed curve is as found in “a”. Those segments are given as enter to neural community classifier. Anshul Mehta [2] used Fourier descriptor for extracting unique characteristic from a character. To begin with boundary is detected, then discrete Fourier coefficient $a[k]$ and $b[k]$ are calculated for $0 \leq k < L-1$. Where L is the full quantity of boundary factors. Fourier descriptor [8] can be used with one new technique called Border Transition approach (BTT).In it each character is partitioned into four same quadrants. The scanning and calculation of black-to-white transition take location in each vertical and horizontal directions in every quadrant. The average transition of each route (horizontal and vertical) in each of the 4 quadrants of the box surrounding the man or woman could be calculated. Rafael M. O [1] used nine modified feature extraction strategies on a single database. Structural characteristics consist in extracting histograms and profiles and mixing then right into a single characteristic vector. In changed part map an $M \times N$ photograph is thinned and scaled into a 25×25 matrix. The Sobel operators are used to extract 4 awesome facet maps: horizontal, vertical and diagonals. Those four maps and the original photograph are divided into 25 sub-photographs of 5×5 pixels every. The capabilities are received calculating the proportion of black pixels in every sub-image (25 functions according to picture). The functions are mixed to form a single

characteristic vector containing one hundred twenty five (25 X five) functions. Photograph Projections includes extracting the radial and diagonal projections. To extract the radial projections, the picture need to first be divided into 4 quadrants: pinnacle, bottom, right and left. Radial projections are acquired through grouping pixels through its radial distance to the middle of the picture in each quadrant one after the other. The diagonal projection is computed absolutely via grouping pixels with the aid of the 2 diagonal traces. The values of every projection are normalized to a variety [0-1] thru the department by the most value. The normalized features are concatenated in an unmarried vector containing 128 functions. In Multi Zoning an $M \times N$ man or woman photo is divided into numerous sub-photographs and the share of black pixels in every Sub-image is used as characteristic. It is a statistical method as capabilities are calculated based totally at the range of pixels used to represent a picture. other function extraction algorithms used are Concavities dimension, MAT-based totally Gradient Directional functions, Gradient Directional functions, Median Gradient functions, Camastra 34D functions[1].

CLASSIFICATION

The category is the manner of identifying each person and assigning to it the precise man or woman magnificence. The class strategies [9] may be categorized as:

- Classical strategies.
- Smooth computing strategies.



The various classical techniques are Template matching, Statistical techniques, Structural techniques. Whereas the numerous gentle computing strategies are neural networks, Fuzzy common sense, Evolutionary computing strategies. Adnan Amin and W. H. Wilson [6] used Neural community for category of characters with 3 layers namely input layer, Output layer and Hidden layer. The geometric capabilities extracted like dot, line, curve or loops are given as input to the input layer. Each aspect of the segmented illustration is classed as a dot, line, curve, or loop. In each case, the characteristics of the aspect are decided: if a line, what are its orientation and its length relative to the character body - short, medium or lengthy. One enter neuron is used to encode each of those possible picks (short/medium/lengthy) and every of 4 viable orientations for a line. One enter neuron is used to encode the characteristics of each issue extracted with the aid of geometric feature extraction technique. Neuron has modes of operations as education mode and testing mode.

Inside the training mode, the neuron can be trained to hearth (or no longer), for

particular input patterns. If the input pattern does not belong within the taught list of enter styles, the firing rule is used to decide whether or not to hearth or no longer. Anshul Mehta, Manisha Srivastava [2] used 3 networks for the popularity of 26 lowercase and 26 higher case letters as Multilayer notion(MLP)[2,8], Radial foundation feature (RBF) and aid Vector gadget(SVM).Multilayer belief is a feed ahead neural network with one or extra layers among input and output layer. Radial foundation characteristic (RBF) networks commonly have 3 layers: an input layer, a hidden layer with a non-linear RBF activation function and a linear output layer.

Submit-Processing

POST-PROCESSING

Submit-processing especially consists of two obligations –output string generation and errors detection/correction. Output string generation will reassemble the strings which have been separated in the procedure of segmentation while mistakes detection/correction will accurate mistakes with the help of dictionary.

Researcher	Pre-processing	Segmentation	Extraction	Classification & recognition	Efficiency
A.George et.al.[3]	-	Horizontal histogram profile, vertical histogram profile	Contourlet transform	Feed forward back propagation neural network algorithm	97.3%
k.singh et.al.[4]	Median filtration, dialation some morphological operations	-	Zoning Density (ZD) and Back-ground Directional Distribution (BDD) features	SVM (support vector machines) classifier	95.04%



A. Desai[5]	Adaptive histogram equalization algorithm, median filter and nearest neighborhood interpolation algorithm, skew correction		Feature vector of four different profiles- horizontal, vertical and two diagonals	Feed forward back propagation neural network	81.66%
Md.saidur et.al.[6]	Canny method, using thinning and dilation algorithm		Four directional local feature vector by kirsch mask and one global feature vector	PCA and SVM	92.5%
R.Singh&M.Kaur[7]	Adaptive sampling algorithm, Otsu's threshold algorithm and hilditch algorithm		Character height and width, the number of horizontal, vertical lines and slop lines, special dots	Back propogation algorithm	
J. John et.al.[8]	-	Projection analysis, connected component labeling	Haar Wavelet features	SVM classifier with RBF (Radial Basis Function) kernel	90.25%
A. Aggarwalet.al.[9]	Threshold value, Median filtering		Gradient feature	SVM with RBF kernel as a classifier	94%
S. Niranjn et.al.[10]			Fisher Linear Discriminate analysis (FLD), 2DFLD, and diagonal FLD based methods	Different distance measure techniques	For angle distance measure 68% for FLD, 68% for 2D-FLD, 66% for Dia-FLD
N. Patil et.al.[11]			Moment Invariants (MIs), Affine moments Invariants (AMIs), image thinning, structuring the image in box format	Fuzzy Gaussian membership function	MIs gives 75 %AMI gives 89.09% and combination approach of MIs & AMIs gives 52.90 %
V. Agnihotri[12]	Threshold value, sobel technique, dilation, filling holes	Labeling process	Diagonal feature extraction	Forward Back Propagation neural network	97% for 54 features and 98% for 69 features

Conclusion

The most important processes used inside the subject of handwritten individual popularity over the past decade were reviewed in this paper. Different pre-processing, segmentation, feature

extraction, type strategies are also mentioned. Although, numerous techniques for treating the trouble of hand written English letters have evolved in remaining decades, nonetheless numerous studies is needed in order that a feasible software program answer can be made available. The prevailing OCR for



handwritten has very low accuracy. We need an efficient solution to resolve this trouble in order that typical performance may be increased.

REFERENCES

- [1]. Rafael M. O. Cruz, George D. C. Cavalcanti and Tsang Ing Ren "An Ensemble Classifier For Offline Cursive Character Recognition Using Multiple Feature Extraction Techniques" IEEE 2010.
- [2]. Anshul Mehta, Manisha Srivastava, Chitralekha Mahanta "Offline handwritten character recognition using neural network" IEEE 2011 International conference on computer applications and Industrial Electronics.
- [3]. Oivind Due Trier, Anil K Jain and Torfinn Text "feature extraction methods for character recognition- a survey" 1996
- [4]. Jayashree R Prashad, Dr. U V kulkarni "Trends in handwriting recognition" IEEE 2010, Third international conference on emerging trends in engineering and technology.
- [5]. Christopher E. Dunn and P. S. P. Wang "Character Segmentation techniques for handwritten text-A Survey" IEEE 1992.
- [6]. Adnan Amin and W. H. Wilson "Hand-Printed Character Recognition System Using Artificial Neural Networks" IEEE 1993.
- [7]. Puttipong Mahasukhon, Hossein Mousavinezhad, Jeong-Young Song "Hand-Printed English Character Recognition based on Fuzzy Theory" IEEE 2012
- [8]. Yuk Ying Chung, Man to Wong "handwritten character recognition by Fourier descriptors and neural network" IEEE 1997, Speech and Image Technologies for computing and telecommunication
- [9]. Shabana Mehrez, Gauri katiyar "Intelligent Systems for Off-Line Handwritten Character Recognition: A Review" International Journal of Emerging Technology and Advanced Engineering 2012.
- [10]. Nafiz Arica and Fatos T. Yarman-Vural "An Overview of Character Recognition Focused on Off-Line Handwriting." IEEE 2001.
- [11]. Sameer singh, Adnan Amin "Neural network recognition and analysis of hand printed letters. IEEE 1998.
- [12]. Aji George and Faibin Gafoor, Contourlet Transform based Feature Extraction for Handwritten Malayalam Character Recognition using Neural Network, International Journal of Industrial Electronics and Electrical Engineering, Vol. 2, Issue-4, 2014, pp.19-22.
- [13]. Kartar Singh Siddharth, Renu Dhir and Rajneesh Rani, Handwritten Gurumukhi Character Recognition using Zoning Density and Background Directional Distribution Features, International Journal of Computer Science and Information Technologies, Vol.2(3), 2011, pp.1036-1041
- [14]. Apurva A. Desai, Gujarati handwritten numeral optical character reorganization through neural network, Pattern Recognition, Vol. 43, 2010, pp. 2582-2589
- [15]. Md.Saidur Rahman, G. M. Atiqur Rahman, Asif Ahmed and G.M. Salahuddin, An Approach to Recognize Handwritten Bengali Numerals for Postal Automation, International Conference on Computer and Information Technology, 2008, pp. 171-176.
- [16]. Niranjan S.K, Vijaya Kumar, Hemantha Kumar G and Manjunath Aradhya V N, FLD based Unconstrained Handwritten Kannada Character Recognition, International Journal of Database Theory and



Application, Vol. 2, No. 3, 2009, pp. 21-26.

[17]. M. Blumenstein, B. Verma and H. Basli, "A Novel Feature Extraction Technique for the Recognition of Segmented Handwritten Characters", Proceedings of the Seventh International Conference on Document Analysis and Recognition (ICDAR'03) 0-7695-1960-1/03 \$17.00 © 2003 IEEE.

[18]. Sumedha B. Hallale, Geeta D. Salunke, "Twelve Directional Feature Extraction for Handwritten English Character Recognition", International Journal of Recent Technology and Engineering (IJRTE) ISSN:2277-3878, Volume-2, Issue-2, May 2013.

BIOGRAPHIES



K.Nithya working as Assistant Professor in the department of computer science and engineering, Nandha College of

Technology, Erode. She has three years of teaching experience. Her area of interest are Image Processing, and Data Mining. Her publications include three international journals.



M.Saranya working as Assistant Professor in the department of computer science and engineering,

Nandha College of Technology, Erode. She has three years of teaching experience. Her area of interest are Image Processing, and Data Mining. Her publications include five international journals.