PATTERN MATCHING AND ANALYSIS OF HANDWRITTEN DIGITS REVIEW

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Abstract**:** *Finding correspondences between objects(digits) is a fundamental problem in computer vision, computer graphics, and geometry processing, with applications in a variety of areas, such as medicine, biology and archaeology [1,2]. The recognition of handwritten digits is a challenging task in the field of image processing and pattern recognition. In this proposed method where a digit is identified and analysis by its normalization, feature extraction. Various handwritten digits from forms or peripheral devices etc. are recognized with the help of various pre-processing and image enhancement techniques. Fourier Descriptors is used for recognized irrespectively of digits position, size and orientation.*

Keywords- Pattern matching; **handwritten digits recognition**; **Offline handwriting recognition**; **online handwriting recognition;related work; Multicast Support Vector Machine; Feature extraction.**

I. INTRODUCTION

Optical character recognition, usually abbreviated to OCR is the mechanical or electronic translation of images of handwritten, typewritten or printed text into machine-editable text or computer process-able format, such as ASCII code. Whenever a page is scanned, it is stored as a bit-mapped file. When the image is displayed on the screen, we can read it. But it is just a series of dots for the computer. The computer does not recognize any "words" on the image. OCR makes the computer read these words. It looks at each line of the image and determines which particular character is represented by dots.OCR is a field of research in pattern recognition, artificial intelligence and machine vision. Optical character recognition (using optical techniques such as mirrors and lenses) and digital character recognition (using scanners and computer algorithms) were originally considered separate fields. Because very few applications survive that use true optical techniques, the OCR term has now been broadened to include digital image processing as well.

The recognition of handwritten digits by computer has been a topic of intensive search for many years. Handwritten numeral recognition is always the research focus in the field of image process and pattern recognition. The numeral varieties in size, shape, slant and the writing style make the research harder. The numeral digit recognition is the most challenging field, because the big research and development effort that has gone into it has not solved all commercial and intellectual problems. Handwritten numeral digit recognition is an important step in many document processing applications. Digital document processing is gaining popularity for application to office and library automation, bank and postal services, publishing houses and communication technology [3].

II. RELATED WORK

Pattern recognition is an area of study that is well-established and known through years of research, especially in the field of digit recognition which is considered one of the obvious challenges and one of the significant contributors to digit recognition. However, Arabic digits recognition is considered the recent major areas that attract researcher's attention. Arabic digits recognition attracts researchers into mainly two areas; first, a hierarchical division of the input letter space to easily solve the problem. Second, a heuristically defined rule for classification or feature selection, which is depend on both the writer and the written material (data).

Genetic programming techniques for hand written digits recognition was applied by on the USPS data set.

Some variations appears on the selection and evolution methods which normally used accompanied by genetic programming systems such as aged members, directed crossover, inter-output crossover and node mutation. This genetic approach shows a promising result where the accuracy rate reaches 84.3% using inter- output crossover using 19 features.

The Bayesian decision theory is a system that minimizes the classification error. This theory plays a role of a prior. This is when there is priority information about something that we would like to classify. For example, suppose we do not know much about the fruits in the conveyer belt. The only information we know is that 80% of the fruit in the conveyer belt are apples, and the rest of them are oranges. If this is the only information we have, then we can classify that a random fruit from the Conveyer belt is apple. In this case, the prior information is the probability of either an apple or an orange is in the conveyer belt. If we only have so little information, then we would have the following rule:

Decide"apple'if P (apple) > P (orange), otherwise decide" orange' Here, P (apple) is the probability of being an apple in the conveyer belt. This means that P(apple) = 0.8 (80%). This is probably strange, because if the above rule is used, then we are classifying a random fruit as an apple. But if we use this rule, we will be right 80% of the time. This is a simple example and can be used to understand the basic idea of pattern recognition. In real life, there will be a lot more information given about things that we are trying to classify. For example, we know that the color of the apples is red. Therefore if we can observe a red fruit, we should be able to classify it as an apple. We can have the probability distribution for the color of apples and oranges. Let wapp represent the state of nature where the fruit is an apple, let w ora represent the state of nature where the fruit is an orange and let x be a continuous random variable that represents the color of a fruit. Then we can have the expression p(x|w) representing the density function for x given that the state of nature is an apple. In a typical problem, we would be able to calculate the conditional densities p (x|wapp) for j so it will be either an apple or an orange. We would also know the prior probabilities P(wpp) and P(wora). These represent the total number of apples versus oranges in the conveyer belt. Here we are looking for a formula that will tell us about the probability of a fruit being an apple or an orange just by observing a certain color x. If we have the probability, then for the given color that we observed, we can classify the fruit by comparing it to the probability that an orange had such a color versus the probability that an apple had such a color. If we were more certain that an apple had such a color, then the fruit would be classified as an apple. So, we can use Baye's formula, which states the following: $P(w|x) = p(x|wj)\ P(wj)/p(xj)$.

III. HANDWRITTEN DIGITS RECOGNITION

A very relevant present-day field of natural interface research is hand writing recognition technology. Handwriting Recognition is the ability of a computer to receive and interpret intelligible handwritten input from sources such as paper documents, photographs, touch-screens and other devices. It is improving the interface between man and machine in many applications. Handwriting recognition is comparatively difficult, as different people have different handwriting styles. Handwriting Recognition is of two types: Offline handwriting Recognition (Offline: Data is collected before the processing start) Online handwriting Recognition (Online: Data is captured as it is written) On-line handwriting recognition involves the automatic conversion of text as it is written on a special digitizer or PDA, where a sensor picks up the pen-tip movements as well as pen- up/pen-down switching. That kind of data is known as digital ink and can be regarded as a dynamic representation of handwriting. Off-line handwriting recognition involves the automatic conversion of text in an image into letter codes which are usable within computer and text-processing applications. Handwriting recognition inherited a number of technologies from Optical Character Recognition

(OCR). OCR engines are used for machine printed text and ICR for hand "printed" text. Till date there is no OCR/ICR for handwriting Recognition. For recognition the techniques used are: Neural Network, Support Vector Machine, Dempster-Shafer Theory, Hidden Markov Model, Octal Graphs Technique, Genetic Algorithms, and Elastic Matching Method [4].

IV. MULTICAST SUPPORT VECTOR MACHINE

SVMs as better candidates for performing handwritten digits recognition. One advantage of SVMs is that their solutions are sparse, so, unlike KDA, they do not require the entire training set to be always available during evaluation. Only a (typically small) subset will be needed. This subset is what is commonly called "support vectors". One advantage of SVMs is that their solutions are sparse, so, unlike KDA, they do not require the entire training set to be always available during evaluation. Only a (typically small) subset will be needed. This subset is what is commonly called "support vectors". Support Vector Machines (SVMs) are a set of related supervised learning methods which can be used for both classification and regression. Unfortunately, unlike KDA, Support Vector Machines do not generalize naturally to the multi-class classification case. SVMs are binary classifiers, and as such, in their original form, they can only decide between two classes at once. However, many approaches have been suggested to perform multi-class classification using SVMs

Support Vector Machines (SVMs) are a set of related supervised learning methods which can be used for both classification and regression. In simple words, given a set of training examples, each marked as belonging to one of two categories, an SVM classification training algorithm tries to build a decision model capable of predicting whether a new example falls into one category or the other. A linear support vector machine is composed of a set of given support vectors **z** and a set of weights **w**. The computation for the output of a given SVM with N support vectors z_1, z_2, z_N and weights w_1, w_2, ..., w_N is then given by[7,8].:

$$F(x) = \sum_{i=1}^{N} w_i \langle z_i, x \rangle + b$$

V. FEATURE EXTRACTION

When the input data to an algorithm is too large to be processed and it is suspected to be notoriously redundant (much data, but not much information) then the input data will be transformed into a reduced representation set of features (also named features vector). Transforming the input data into the set of features is called feature extraction. If the features extracted are carefully chosen it is expected that the features set will extract the relevant information from the input data in order to perform the desired task using this reduced representation instead of the full size input. The purpose of feature extraction is to reduce image data by measuring certain features or properties of each digit.

VI. PROPOSED SYSTEM

Digit Recognition

Recognition of handwritten characters is a very complex Problem. The characters could be written in different size, Orientation, thickness, format and dimension.

Proposed system

First input digits scanned with help of input devices then Scanned image is converted in file format. Feature extraction removes the salt and noise with the help of median filter and image is inverted white image with Black background. Segmentation applies to images and converted into 8x8 Grid i.e.64 bits. Support Vector Machines (SVMs) are a set of related supervised learning methods which can be used for both classification and regression.

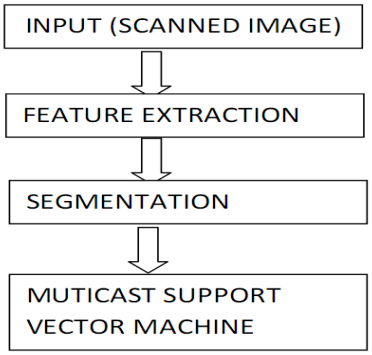

Fig. 1 Overview of Pattern Matching and Analysis of Handwritten Digits Using Multicast Support Vector Machine.

VI. CONCLUSION

Proposed system is based on pixel by pixel values matchingwith standard database. Feature extraction removes the salt and noise with the help of median filter and image is inverted white image with Black background. Segmentation applies to images and converted into 8x8 Grid i.e.64 bits. Support Vector Machines (SVMs) are a set of related supervised learning methods which can be used for both classification and regression.

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