Recognition System of Handwriten Craft Motive Using Based Feature Extraction and Neural Network

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Abstract: - In this paper, a diagonal feature extraction scheme for the recognizing an off-line handwritten motive is presented. In the feature extraction process, resized individual images motives of our base of the models "handwritten motives of crafts" of size 100x60 pixels is further divided into 60 equal zones, each of size 10x10 pixels. The features are extracted from the pixels of each zone by moving along their diagonals. This procedure is repeated for all the zones leading to extraction of 60 features for each basic image motives. These extracted features are used to train a feed forward back propagation neural network employed for performing classification and recognition tasks. Extensive simulation studies show that the recognition system using diagonal features provides good recognition accuracy while requiring less time for training.

Key-Words: - Feature extraction; recognition; neural networks; Image processing; handwritten Craft motives

1 Introduction

Machine simulation of human functions has been a challenging research field since the advent of digital computers. In some areas, which require certain amount of intelligence, such as handwriting recognition, thus Handwriting recognition plays an important role in this modern world. Handwriting recognition has been one of the most fascinating and challenging research areas in field of image processing and pattern recognition in the recent years [1] [2]. It contributes immensely to the advancement of an automation process and can improve the interface between man and machine in numerous applications. Several research works have been focusing on new techniques and methods that would reduce the processing time while providing higher recognition accuracy [3].

In general, handwriting recognition is further divided into two domains: Offline handwritten recognition and Online handwritten recognition:

In case of offline recognition, the typed handwritten are scanned and then converted into binary or gray scale image. Then feature extraction and recognition process is carried over the binary image. Offline recognition is a more challenging and difficult task as there is no timing information about character strokes is available. Therefore offline recognition is considered as a more challenging task then its online counterpart.

In case of Online handwritten form recognition is also known as real time recognition of forms. In this case writing and recognition are done simultaneously. User will write character on any sensory area where sensors will pick up the pen movements and then on the basis of those pen movements forms are recognized. Online form recognition is much easier than offline form recognition, because timing information is available there.

However, in the off-line systems, the neural networks have been successfully used to yield

comparably high recognition accuracy levels. Several applications require off-line handwriting recognition systems. As a result, the off-line handwriting recognition continues to be an active area for research towards exploring the newer techniques that would improve recognition accuracy [4] [5].

The first important step in any handwritten recognition system is pre-processing followed by segmentation and feature extraction. The pre-processing is a series of operations performed on the scanned input image. It essentially enhances the image rendering it suitable for segmentation. [6] Pre-processing phase enhances the image rendering. The various tasks performed on the image in pre-processing stage are binarization process that converts a gray scale image into a binary image and many more. In the segmentation [7] [8], the input image is segmented into individual motifs and then, each motif is resized into m x n pixels towards the training network.

Feature extraction is a method of automatic pattern recognition in which recognition is achieved by making measurements on the patterns to be recognized, and then deriving features from these measurements [9] [10]. The Selection of appropriate feature extraction method is probably the single most important factor in achieving high recognition performance. Several methods of feature extraction for character recognition have been reported in the literature. The widely used feature extraction methods are Template matching, Histograms, Contour, Geometric moment invariants, Zernike moments, Racah moments, Approximation polygonal, Fourier descriptors.

An artificial neural Network as the backend is used for Performing classification and recognition tasks. In the off-line recognition system, the neural networks have emerged as the fast and reliable tools for classification towards achieving high recognition accuracy. In the literature methods of classification include statistical methods based on Bayes decision rule, Artificial Neural Networks (ANNs), Kernel Methods including Support Vector Machines (SVM) and multiple classifier combination [11], [12].

The object of this paper is the pattern recognition of handwritten Craft Motives Images. It is appropriate in one the first time to evaluate and feature extraction the image by a new method, called, diagonal based feature extraction is introduced for extracting the features of the handwritten craft motives. We will compare then the signature of the objects to be recognized, with those of a database of known models objects using for training multilayer feed forward neural network is described in the paper algorithm of recognition proposed. The proposed recognition system performs quite well yielding higher levels of recognition accuracy compared to the systems employing the conventional horizontal and vertical methods of feature extraction.

The paper is organized as follows. In section II, the proposed recognition system is presented. The feature extraction procedure adopted in the system is detailed in the section III. Section IV describes the classification and recognition using neural network. Section V presents the experimental results and, the paper is concluded in section VII.

2 The Proposed Recognition System

2.1 Diagram of the proposed system

In this section, the proposed recognition system is described. A typical handwriting recognition system consists of pre-processing, segmentation, feature extraction, classification and recognition, and post processing stages. The schematic diagram of the proposed recognition system is shown in Fig.1.

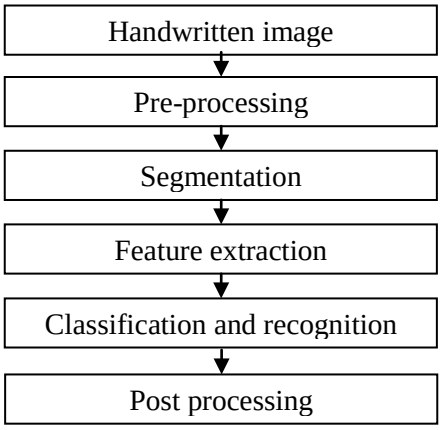

Fig.1: Diagram of the proposed recognition system

The pre-processing is a series of operation performed on the scanner input image. It essentially enhances the image rendering it suitable for segmentation. The various tasks performed on the image in pre-processing stage shown in Figure.2. Binarization process converts a gray scale image into a binary image using thresh holding technique. Detection of edges in the binarized image using canny technique, Skeletonization the image are the operations performed in the last two stages to produce the pre-processed image suitable for segmentation. The skeletonization process will be

used to binary pixel image and the extra pixels which are not belonging to the backbone of the character has been deleted and the broad strokes has been reduced to thin lines using the polygonal approximation [13].

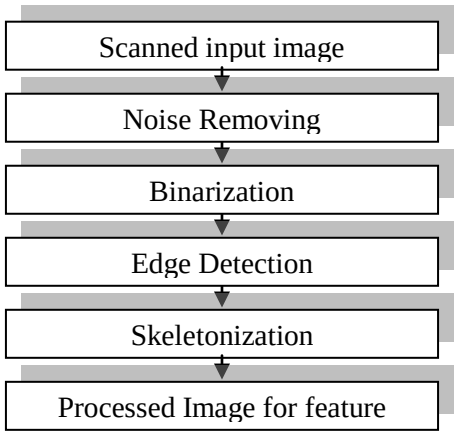

Fig.2: Pre-processing of handwritten character

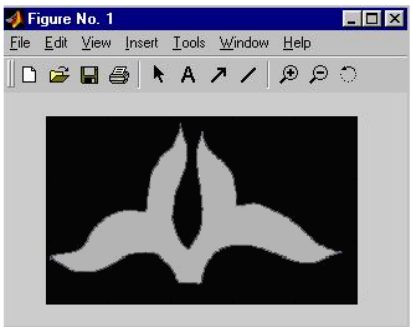

Fig.3: Example of a motive for the database.

2.2 Segmentation

In the segmentation stage, an image motive "Zewaka" is decomposed into sub-images of basic motive. In the proposed system, the pre-processed input image is segmented into isolated basic motive by assigning an identifier to each basic motive using a labeling process. This labeling provides information about each basic motive in the image initial. Each individual basic motive is uniformly resized into 100x60 pixels for classification and recognition stage.

3 Purposed Feature Extraction Method

The feature extraction stage analyzes a handwritten motive image and selects a set of features that can be used for the classification of input motive. In proposed system diagonal feature extraction approach is selected for extracting the features from input image [14]. Every character image of size 100x 60 pixels is divided into 60 equal zones, each of size 10x10 pixels. The features are extracted from each zone pixels by moving along the diagonals of its respective 10X10 pixels. Each zone has19 diagonal lines and the foreground pixels present along each diagonal line are summed to get a single sub feature and thus 19 sub-features are obtained from the each zone. These 19 sub-features values are averaged to form a single feature value and placed in the corresponding zone. This procedure is sequentially repeated for the all the zones. Finally, 60 features are extracted for each character. [4] In addition, 10 and 6 features are obtained by averaging the values placed in zones row wise and column wise, respectively. As result, every character is represented by 76, that is, 60 +16 features.

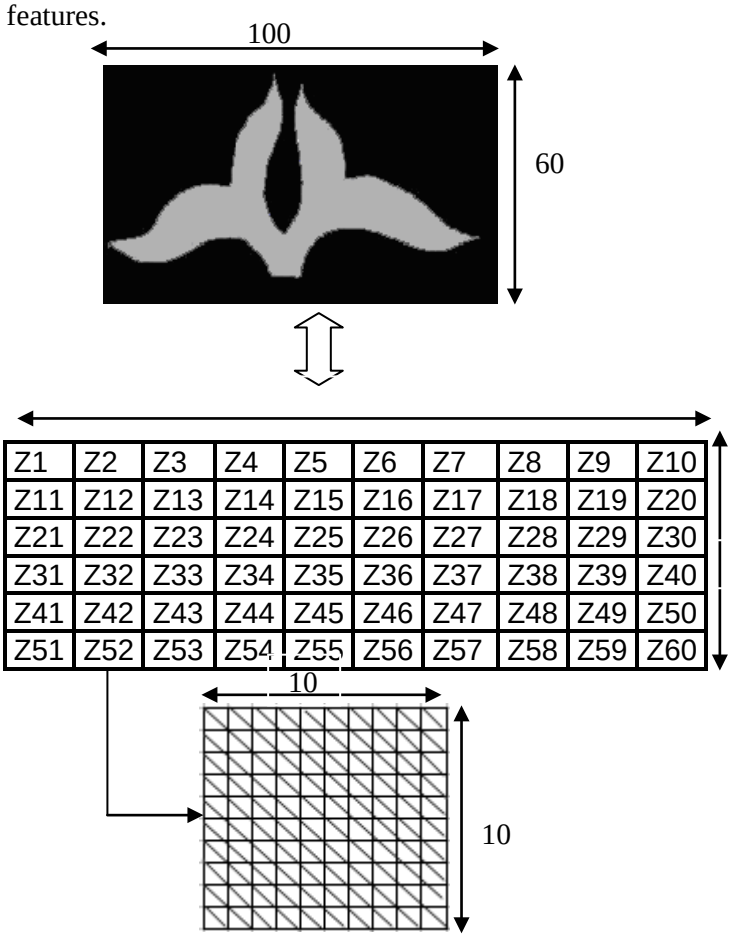

Fig.4: Procedure for extracting feature from the motive

These extracted features are used to train a feed forward back propagation neural network for performing classification and recognition tasks.

4 Classification and Recognition

The classification stage is the decision making part of a recognition system and it use the features extracted in the previous stage. It is very important stage, in this stage input is classified that in which class particular input is belong. It very beneficial in recognizing handwritten motives which the feature are extracted from pervious stage are used to form neural network. In this paper, for Motive handwritten recognition in neural Feed Forward Multi-Layer Perceptron network (MLPN) with two hidden layer has been used. For training, back-propagation algorithm has been implemented [15].

In general the feature vector is denoted as X, and defined as X = (f1, f2,…, fd), where f denotes features and d is the total number of the features present in the each motive. The number of input neurons is determined by length of the feature vector d (d=76). The total numbers of motives n determines the number of neurons in the output layer (n=30 basic motives of handwritten craft).

All the neurons use log-sigmoid transfer functions. The back propagation algorithm with momentum and adaptive learning rate is used to obtain the parameters of the network. Two Hundred different handwritten data sets were used for training the neural network. The number of hidden layers and the number of neurons in each layer are to be obtained through trial and error. Through numerous simulations it was identified that a maximum of two hidden layers and a maximum of 100 neurons in each hidden layer would be sufficient for motive recognition. Further increase in the number of neurons did not considerably improve the accuracy. The parameters of the trained network are fixed to enable testing. The architecture of the three layer neural network for the handwritten recognition system is shown in Figure.4. The most compact network is chosen and presented.

Table 1 : Feedforward Neural Network Training Parameters

Input nodes	76
Hidden layers	2
Hidden layers nodes	100
Output nodes	30
Training epochs	50000
Training algorithm	Gradient descent with momentum training and adaptive learning
Performance function	Mean Square Error (MSE)
Training goal achieved	10e-7

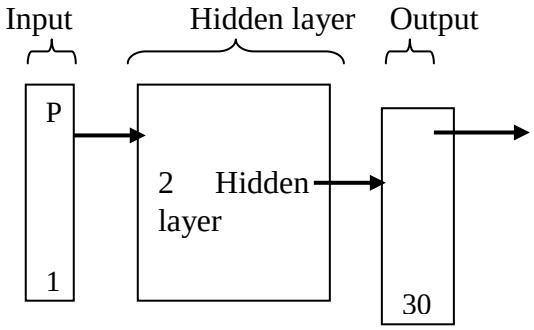

Fig.5: Two hidden layer neural network for motive recognition

The output of the i^{th} layer is defined by

$$a^i = \log sig(w^i a^{i-1} + b^i) \quad (1)$$

Where,

$a^0 = P$ and $\boldsymbol{i} = [1,2,3]$;

w^i = Weight vector of i^{th} layer

a^i = Output of i^{th} layer

b^i = Bias vector for i^{th} layer

P = input vector for the network

5 Results and Discussion

A simple and an efficient off-line handwritten motive recognition system using a new type of feature extraction, namely, diagonal feature extraction is proposed. This approach using training and testing features are chosen to build the neural network recognition system. The structure of neural network includes an input layer with 76 inputs including row wise and column wise features, two hidden layers each with 100 neurons and an output layer with 30 neurons. The gradient descent back propagation method with momentum and adaptive learning rate and log-sigmoid transfer functions is used for neural network training. Neural network has been trained using known dataset. A recognition system using simple diagonal based feature. Show the efficient of this system, we compare this system with another system such as the system using radial basis classifier and nearest neighbour classifier.

The experimental results obtained in recognizing the handwritten motive using different classifiers are summarized in Table.2. The results in Table 2 indicate the superior recognition accuracy of Feed forward neural network as compared to other classifiers. Using a motive of handwritten test data the confusion matrix was obtained for the different classifiers. This was to investigate the recognition accuracy for each motive. Among the NN based classifiers the Feed forward neural network recognizes each motive with over 90% accuracy and is the best classifier.

Table 2*: Summary of the results achieved by the proposed methods*

Classifier	N. of motives with recognition	% recogniti on
Feed Forward NN	28	93%
Nearest neighbour NN	26	86%
Radial basis function NN	27	90%

6 Conclusion

In this paper, a system for recognizing off-line handwritten craft motive has been developed. This recognition system uses new type of feature extraction, namely, diagonal feature extraction is proposed. Different Pre-processing, segmentation techniques and classifier neuronal with different features are also discussed.

This approach using training and testing features are chosen to build the neural network recognition system. The structure of neural network includes an input layer with 76 inputs including row wise and column wise features, two hidden layers each with 100 neurons and an output layer with 30 neurons.

From the results it can be concluded that combination of Neural Network classifier and diagonal feature extraction approach is best method for the recognition of handwritten craft motive.

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