Handwritten Gurmukhi Characters Recognition

Er. KULBIR KAUR, Er. HARPREET KAUR, Er. JASPREET KAUR

Abstract— Hand Writing detection is a meadow of research in pattern detection; different people have a different hand writing, so hand Handwriting detection is a difficult task or one of the difficult problems in the field of hand writing detection and also number detection. Still academic research in the field continues, the hub of character detection has shifted to implementation of confirmed techniques .OCR is one of the best technique for recognition system. OCR basically used in two modes, first one is offline mode and second one if online mode. The endeavor of this paper is to create a new handwritten character recognition method. This paper deals with recognition of inaccessible handwritten gurmukhi characters using Neural Network and Particle Swarm optimization neural network Algorithm.

Index Terms— **NN, PSONN, Feature extraction, OCR**

I. INTRODUCTION

Gurmukhi characters [1][2] is the most common used for writing the Punjabi language. Gurmukhi was harmonized by the second Sikh guru, Guru Angad Dev Ji. The name Gurmukhi is derived from the old Punjabi term "Gurmukhi" meaning "from the mouth of the Guru". Handwriting detection has been studied for almost forty years and there are many proposed approaches. The problem is somewhat complex, and now there is no particular approach that solves it both professionally and absolutely in all settings [3]. We perceive numerous people using handwriting across a thick range of applications counting schools, hospitals, banking, insurance, government, and mores. Optical character recognition is one of the best techniques for handwritten character recognition system. Two different modes are used under OCR technique one is offline mode and other one is online mode. We work in offline mode, which used wavelet transform [4]. OCR is the electronic conversion of scanned images of typewritten or printed text into computer readable text

II. METHOD DESCRIPTION

Submit your manuscript electronically for review. The proposed work attempts to merge two methods for handwritten character recognition, Neural Network and Particle swarm optimization neural network. The system consists of the pre-processing then feature extraction then neural network and PSONN algorithm. In our proposed work first of all select the particular character image. Then crop the selected image, then pre processing and after then train the neural network. If result is correct then select other character and if result is uncorrected because of different shape of handwritten character then again train the neural network with PSONN. Fig. 1 show the basic block diagram of method description.

A. Select & Crop Image

Select the particular character from the scanned document and then crop it. The character selects in rectangular shape or may be in any other shape. Crop imaged is now ready for the pre-processing and for feature extraction.

B. Pre-Processing

First of all RGB image is convert into binary image. For binary conversion, threshold value is compare with image. Threshold value decided automatically from maximum colure of image and minimum colure of image. If threshold value is greater than input value then output is 1 and if threshold value is less than input value then output is 0. When image converted into binary image then white portion from image is also remove. Fig no. 1 shows the block diagram of method description.

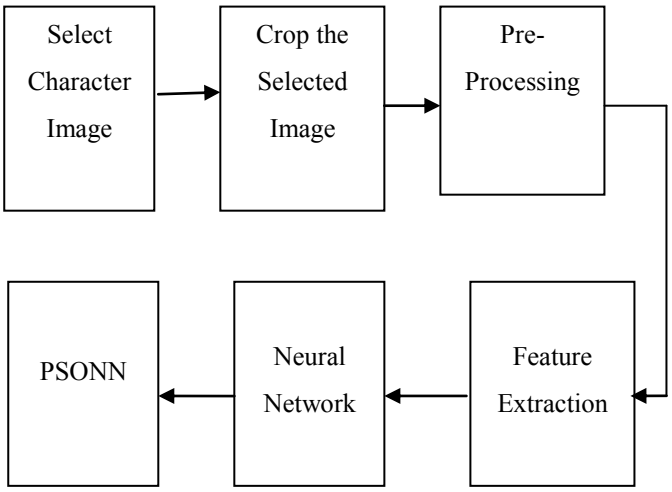

Fig no.1-block diagram of method description

C. Feature Extraction

Feature extraction is the important measure which is worn to extract the most relevant information which is further used to sort the objects. In our proposed work, we have used some features. And these features are.[5]. Area: Area of characters

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in a binary image, the number of non-zero pixels in a character. Orientation: Orientation is the angle in degrees ranging from -90 to 90 degrees between the x-axis and the major axis of the ellipse that has the same second moments as the region. Eccentricity: The eccentricity is the ratio of the distance between the foci of the ellipse and its major axis length. The value is between 0 and 1.Zone density: In zoning, the character image is first resized into 32*32 pixel size and then divided into N*M zones where N is the number of rows and M is the number of columns. The density of each zone is obtained by dividing the foreground pixels in each zone by total number of pixels in each zone. Projection Histogram: Projection histograms count the number of pixels in a particular direction and that direction can be horizontal, vertical or diagonal[6]. In this approach, the character image is resized into 32*32 pixel size. The projection histograms are computed by counting the number of foreground pixels. In horizontal histogram these pixels are counted by row wise. Similarly, we can count the number of foreground pixels column wise and diagonal wise.Gabour Filter: for feature extraction we also used gabour filter. Gabour filter detect edges properly as compare to other filter. Two types gabour filters are used.[7]

GBFM---Gabour filter for magnitude.

GBFN--- Gabour filter for orientation.

Total 40 gabour filters are used, each filter set at different orientation.

Classification-----The type of neural network model used here is Feed.

D. Neural Network

Neural Network (NN) [8] is a function with adjustable or tunable parameters.. A neural network [3] is a structure involving weighted interconnections between neurons or units. For example a neural network of a one-hidden layer n with inputs, x = x1, x2, x3…….xn. The three inputs, along with a unity bias input, are fed each of the two neurons into the hidden layer. The two outputs from this layer and from a unity bias are then fed into the single output layer neuron. This produces the scalar output Y. The layer of neurons is called hidden layer because the outputs are not directly seen in the data. Each arrow in the Figure 2 corresponds to a real-valued parameter, or a weight, of the network. The values of these parameters are tuned in the training network.

E. PSONN

Particle swarm optimization is a population-based searching method which imitates the social behavior of bird flocks or fish school[9]. The population and the individuals are called a "swarm" and "particles", respectively. Each particle moves in the swarm with a velocity that is adjusted according to its own flying experience and retains the best position, it has ever encountered in memory. The best local and global positions ever encountered by all particles of the swarm are also communicated to all other particles[10]. The advantages of PSO are that there is neither mutation calculation nor overlapping. [11]The popular form of particle swarm optimizer is defined in the following equations.

$$Vid(t+1)= W\Delta Vid(t) + C1R1(Pid(t) – Xid(t)) + C1 R1(Pid(t) – Xid(t))…….(1)$$

$$Xid(t+1)= Xid(t) + Vid(t+1)……(2)$$

Where:

Id= is the velocity of particle I along dimension d.

Xid=is the position of particle I in dimension d.

C1=is a weight applied to the cognitive learning portion.

C2=is a similar weight applied to the influence of the social learning portion.

R1,r2=are separately generated random numbers in the range of zero and one.

W=is the inertia weight.

Algorithm

Step 1: Initialize the position and velocity of a group of particles randomly.

Step 2: The PSO is trained using the initial particles position.

Step 3: The learning error produced from neural network can be treated as particles fitness value according to initial weight and bias.[12]

Step 4: The learning error at current epoch will be reduced by changing the particle position, which will update the weight and bias f the network.

1. The pbest value(each particle's lowest learning error) and
2. The gbest value(lowest earning error in entire learning process)

Step 5: The new set of position by adding the calculated velocity value to the current position value using movement equation (1). Then, the new sets of positions are used o produce to new learning error in feed forward NN.

Step 6: This process is repeated until either the mean square error either minimum or maximum numbers of iterations are met.[13]

Step 7: The optimization output, which is the solution of optimization. Fig No. 2 shows the flow chart of all above steps one by one.

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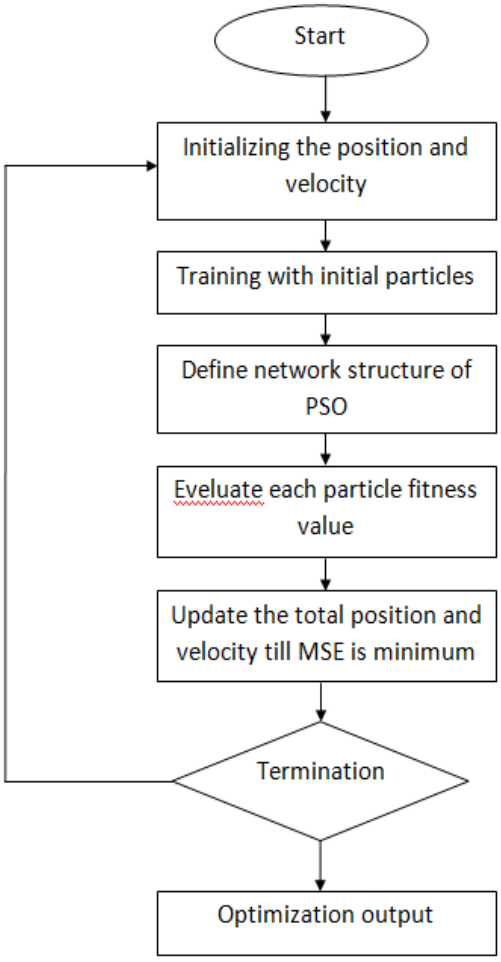

Fig No. 2 Flow Chart of PSONN Algorithm

III. Results & Discussion

There are few cases where neural network is failed to recognize the character because of shape difference in handwriting but PSONN recognized those correctly. The only limitation in case of PSONN is that the selection rectangle has to be kept very small in size otherwise it also give erroneous result as image cropped to edges will not be perfect. The selection of white space in Gurumukhi character selection is covering another character part also, so it is giving a wrong interpretation. That's why white area is selected as small as possible so that no other character part is covered in main selection

A. Performance comparison

Table no 1 show the difference in recognition efficiency with different algorithm. Table also shows the result of this paper. In this proposed work the character recognition efficiency is 99.4% with PSONN algorithm.

Table No. 1

S. No.	Proposed By	Feature Extraction Method	Classifier	Accuracy	Year
1	Anuj Sharma et al	Strokes recognition and matching	Elastic Matching	90.08%	2008
2	Anuj Sharma et al	Loop crossing, Straight line, head line and dots, area, length and shape	Elastic Matching	81.02%	2009
3	Puneet Jhajj et al.	Zoning	SVM	73.83%	2010
4	Munish Kumar et al.	Diagonal & transition feature	K-NN	94.12%	2011
5	Kartar Singh et al.	zonal density, projection histogram,distance profile,BDD	K-NN, SVM, PNN	95.01%	2011
6	Pritpal Singh et al.	wavelet	back prpagation NN	90.40%	2012
7	M. Kumar et al.	MDP feature extraction	Linear SVM, k-NN,MLP	89.20%	2013
8	In my work	zoning density,gabour filter	PSONN	99.4	2014

IV. Conclusion

There is an assortment of ways to recognize the characters that can be handwritten character of any printed character. The major challenge posed in character recognition is by handwritten character recognition. The proposed research work has been focused principally on Gurumukhi character recognition as letters in this are very cursive and to recognize these letters with distinction with every other letter is a difficult task. In the proposed work, the PSONN technique is implemented to achieve the required results. Primarily, all of the preprocessing is done over the scanned input document which is used in recognition. RGB (Red Green Blue) to binary conversion is done and then image is cropped to the edges. For the extraction of features, coordinates of the bounding box are taken out. These bounding box features are then fed to gabor filters which acts as high pass filter, which in turn, is basically a combination of many different filters possessing variety of orientation. The output of these features is

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simulated with the help of neural network database. But, the appropriate recognition of some characters cannot be achieved by neural network because of their shapes, so PSO trained neural network is brought in use. So, in order to train it by PSO input weights and biases of neural network are optimized to minimum mean square error and then the simulation is done by thus created network. It has been observed that PSONN read all characters correctly and even those which were not recognized by neural network. A GUI is constructed for fast processing speed and to make each function operable independent of each other. It also gives a human machine interaction to user so that operation of OCR engine is easy..

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