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Irregular Pattern Recognition Using Artificial Neural Network

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Abstract: Character recognition is the one of the emerging and developing techniques in the field of computer vision and artificial intelligence. one of the ability of humans are recognition, i.e., a person or a character or a thing etc. Characters from a written document can be easily recognized by humans accurately. But the same task is difficult for a machine. Different languages have different types of pattern i.e., they are different from one another. Each character in a language is differing in their patterns, curves, shapes and orientation. So to recognize a character by a machine is difficult. For that we have to train that system to recognize a character. For the character recognition we process the input image, find its features, put classification scheme and train the system using neural network to recognize the character. For this mat lab image processing tool box and neural network tool box are used. It helps to improve the interface between man and machine in numerous applications.

Keywords: Character recognition, handwritten characters, artificial neural network, multilayer feed forward network, resilient backpropagation.

I. INTRODUCTION

Image processing is the manipulation of images using computer in terms of human fascination with visuals. With the development of technology there are several digital techniques to manipulate the images. Image processing is using in several areas like medical filed, printing technology, face detection, biometric processing etc. In the field of artificial intelligence image processing have a significant role. There are several researches are going on for the development of self-thinking and self-learning machines. In that field character recognition have an important role. But it is difficult to do such a task by a machine. For the recognition we have to train that system to classify and recognize a particular character. The character recognition involves several steps like acquisition, noise removal, segmentation, feature extraction, classification and recognition.[1]

For the training of the system artificial neural network is using. Neural network are similar to that of biological neural systems [2]. It is highly interconnected neural systems with parallel computing. For the pattern recognition and the classification highly parallel distributed neuron networks are using. These artificial neural network systems have ability to solve problems due to its self-learning and self-organizing feature. It has highly distributed parallel architecture with large number of nodes and connections. One node is connected to another and is associated with a weight. The neural networks involve the tasks like to determine the network properties node properties and the system dynamics.

II. SCOPE OF THE WORK

Character recognition is the one of the research areas in the field of artificial intelligence. So it has significant role for developing a self-thinking machine. There are several character recognition schemes are available, but each have certain limitations. Most of the recognition schemes recognize only character in fixed font or printed text only. It is difficult recognize a hand written document by a machine accurately. Classical methods in pattern recognition do not as such suffice for the recognition of visual characters due to different person have different mode of writing. Their writing patterns, writing styles and shape of the characters are also different [3]. Several applications including address recognition in post office, bank cheque

processing, document reading require handwriting recognition systems. So researches are going in the field of character recognition for better accuracy.

III. PROPOSED SYSTEM

Character recognition is the conversion of image of handwritten or printed text into machine encoded text. The recognition of characters from scanned images of documents has been a problem that has received much attention in the fields of image processing, pattern recognition and artificial intelligence. In general, images are often corrupted by impulse noise in the procedures of image acquisition and transmission. The noise may seriously affect the character recognition. Hence, an efficient denoising technique becomes a very important issue in image processing. Many image denoising methods have been proposed to carry out impulse noise suppression. Some of them employ the standard median filter or its modifications. However, these methods affect both noisy and noise-free pixels. To avoid the damage on noise-free pixels, an efficient filtering method is used. Otherwise it affects further image processing operations. There are several operations includes in the proposed hand written character recognition system shows in Fig.1.

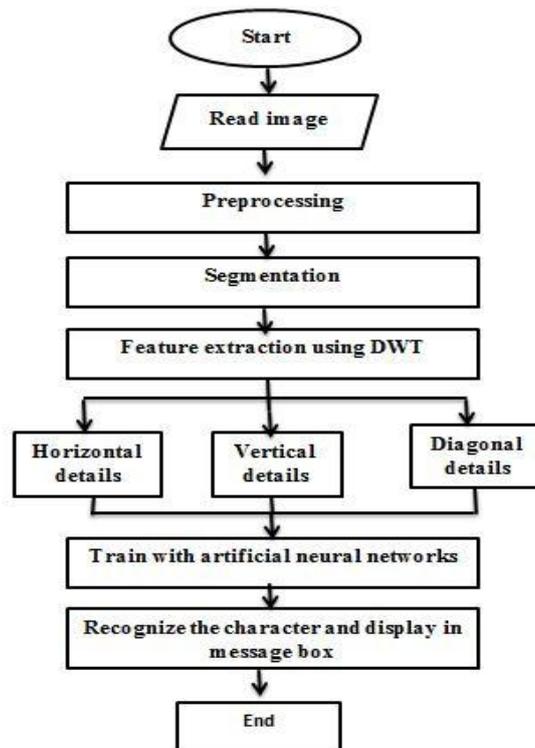


Fig.1. Schematic Diagram of Character Recognition System

a) Image Acquisition

First step in the image processing is image acquisition. To recognize a character from image, system requires a scanned image as an input image. Image should have in a specific format like .BMP, JPEG, JPG etc. Input image is shown in Fig.2.

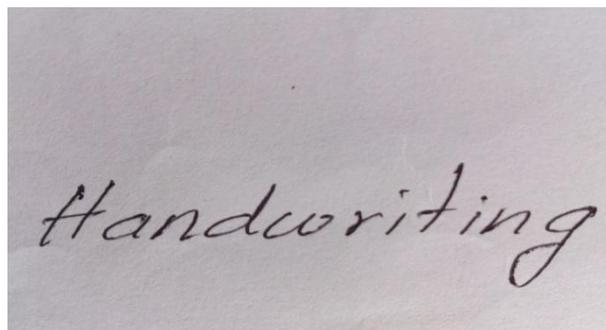


Fig.2. Input image

b) Pre-Processing

The main advantage of preprocessing a handwritten character image is to organize the information so as to make the task of recognition simpler. The major objectives of preprocessing are as follows:

» **Noise reduction:**

During the scanning process, some distortion in images may be introduced due to poor quality of pen, light, handwriting & poor paper quality on which the characters are written etc. It causes some noise in these images. Noise degrades the image quality and information details in the image and it affects further image processing such as segmentation and edge detection. Recognition using computer requires noise free & distortion free images of the characters.

» **Normalization:**

Normalization (resizing of characters) is used to make recognition operations process independent of the writing size and scanning resolution. Normalization methods aim to remove all type of variations during the writing and obtain standardized data. Normalization is done for stroke width, slant, slope, height of letters of the characters. The normalization task will reduce each character image to one consisting of vertical letters of uniform height and made up of one pixel-wide stroke.

» **Binarization:**

Binarization process converts a gray scale image into a binary image. Binary image is shown in Fig.3. Here the pixels have only two values 0 or 1 i.e., black pixels are valued as 0 and white pixels are valued as 1.



Fig.3. Binary Values of Input Image

c) Segmentation

In Segmentation sub divides an image into its constituent regions or objects. Level of sub division depends on the problem being solved. That is segmentation should stop when the objects or region of interest in an application have been detected. Segmentation is mainly edge based and region based segmentation. For segmentation different detection methods like point detection, line detection, edge detections are done. Here morphological operations are other than edge detection, the main processing is performed on purely binary images. They process objects in the input image based on characteristics of its shape which are encoded in the structuring element. Each morphological operator would work on 3x3 neighborhoods in which it applies the laws of operator under consideration. It is then shifted over the image and at each pixel of the image; its elements are compared with the set of underlying pixels. If the two set of elements match the condition defined by the set of operators the pixel under the origin of the neighborhood is to a predefined value.

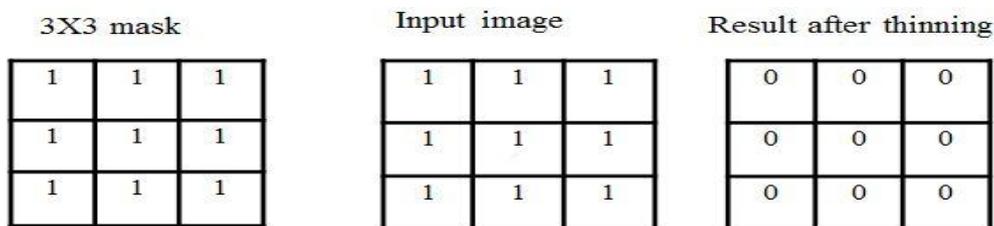


Fig. 4 3X3 mask used for thinning same pixels

3X3 mask	Input image	Result after thinning																											
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Fig. 4 3X3 mask used for thinning same pixels

1. Thinning and edge process

Thinning is a morphological operation used to remove selected fore ground pixels from binary images. It is mainly used for skeltonization. Thinning tidy up the output of edge detectors by reducing all lines to single pixel thickness. Thinning is applied to binary image to get binary output image. Thinning operation is calculated by translating the origin of structuring element of each possible pixel positions in the image and each such position comparing it with the underlying image pixels. If the foreground and back ground pixels in the structuring element exactly match foreground and background pixels in the image then the image pixel underneath the origin of the structuring element is set to back ground i.e. Zero. Otherwise it is left unchanged. Thinned and edge detected image is shown in Fig.4.



Fig. 5. Thinned and Edge Detection

2. Dilate the image with vertical line structuring element

To compute the dilation of a binary input image by structuring element we consider each of the background pixels in the input image in turn. For each background pixel we superimpose the structuring element coincides with the input image so that the origin of the structuring element coincides with the input pixel position. If all least one pixel in the structuring element coincides with a foreground pixel in the image underneath the input pixel is set to the foreground value. If the entire corresponding pixels in the image are background, however the input pixel is left at the background value. Dilated image shown in fig: 5



Fig. 6. Dilated image

d) Feature Extraction

In this stage, the features of the characters that are crucial for classifying them at recognition stage are extracted. It is a special form of reduction. When input algorithm is very large at that time it is reduce the data. If the features extracted 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.

Discrete wavelet transform is used for feature extraction of input handwritten characters. Wavelet analysis can be used to divide the information of an image into approximation and detail sub signals. The approximation sub signals shows the general trend of pixels values and three detail sub signals show the vertical , horizontal and diagonal details or changes in the image. If these details are very small, then they can be set to zero without significantly changing the image. So we get all the features of input image. Fig 6 shows the wavelet transformation.

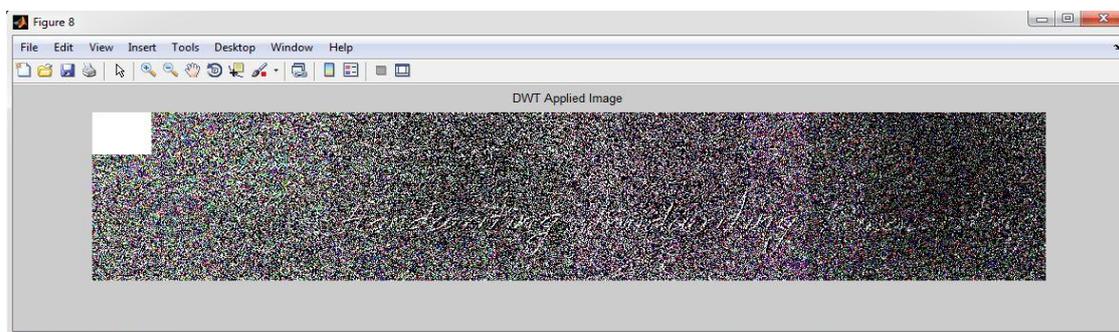


Fig. 7. DWT Applied Image

e) Classification and Recognition

Classification and recognition is the important section in the hand written character recognition system. For this artificial neural networks are used. Artificial neural networks are self-learning and self-organized network systems that are similar to that of biological neural network system. These highly parallel distributed network systems are mainly used for the pattern classification and recognition [5]. In the pattern recognition the neural network system is trained to identify the most similar pattern from the data base that similar to the input image. Neural network system consists of several layers of neurons that are interconnected to each other.

In this system a multilayer feed forward network with one input and one output is created. In this network three hidden layers with different transfer function is used. In the first hidden layer with 60 neurons, second layer with 50 neurons and third layer with 1 neuron are created. Transfer functions used in the first two layers are Log-sigmoid and at third layer linear transfer function is used. To activate a neural system input image is given to the input layer and a weight is assigned to each input node. All the node are connected each other so input node will activate the other nodes. It will continue until the output node will activate. After train neural network, the system is ready to recognize the input hand written images. Different parameters give to the network are:

- » Epochs between displays = 6000
- » Learning rate = 0.20
- » Maximum number of epochs to train = 13000
- » Performance goal = 3e-10

The algorithm used for this character recognition system is Resilient Back propagation algorithm. It is the fastest algorithm for pattern recognition problems and the memory requirements for this algorithm are relatively small in comparison to the other algorithms considered.

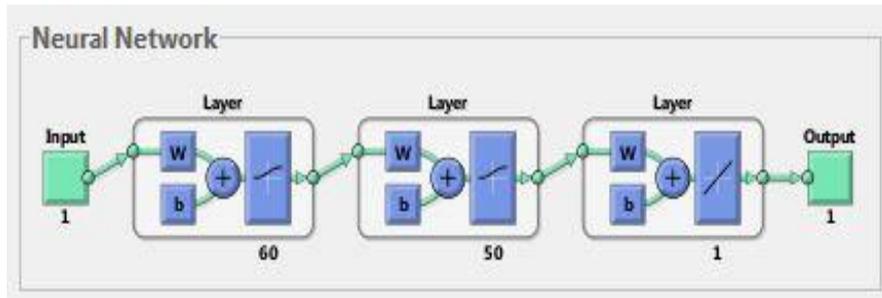


Fig. 5. Multilayer feed forward network

After initializing the input parameters, load input data to the feed forward network for training. Training stops when any of these conditions occurs:

- » The maximum number of epochs (repetitions) is reached.
- » The maximum amount of time is exceeded.
- » Performance is minimized to the goal.
- » The performance gradient falls below min_grad.
- » Validation performance has increased more than max_fail times since the last time it decreased (when using validation).

IV. SIMULATION RESULTS

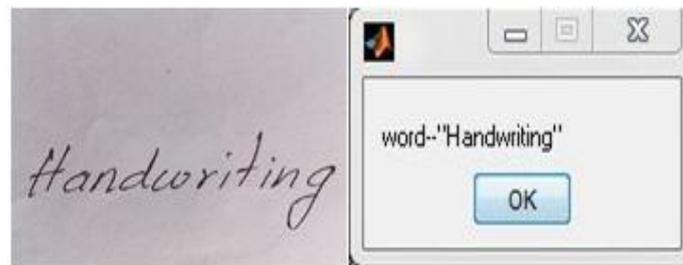


Fig.8. Input and Output of Character Recognition



Fig.9. Input and Output of Character Recognition

V. TOOLS REQUIRED

For the hand written character recognition MATLAB image processing tool box and neural network tool box are used. For preprocessing image processing tool box and for the classification and character recognition neural network tool box is used.

VI. CONCLUSION

Proposed system successfully recognize different hand written words .characters are trained with artificial neural network and it gives an accuracy of 98.7. Existing system recognize only characters in fixed font size or characters in fixed patterns. In this project, system recognizes characters having irregular patterns successfully. For recognition input images are processed

different image processing operations and train the features of input characters with artificial neural network. This system is suitable for several applications including postal address recognition, bank processing, and online exam valuation, forensic science, developing self-learning and self-thinking machines. There are several possible changes that could improve the performance. Here neural network shows the learning ability and adaptability of the system. Though ANN has complexity in computation it offers several advantages in pattern recognition and classification in similar manner close to human intelligence to a small extent. Handwritten character recognition is still a burning research area of pattern recognition. Each and every step contributes directly to the accuracy of system, like preprocessing, segmentation, feature extraction, training methods etc. So all these area are open for independent research. A lot can be improved in each of step of image processing.

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