APPLICATION OF NEURAL NETWORK FOR CHARACTER RECOGNITION

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ABSTRACT

This paper, Character recognition (CR) system created on Artificial Neural Networks (ANNs) is discussed. Neural networks are commonly castoff to solve sample-recognition problems. One of these is character acknowledgement. With the help of Matlab's Neural Network Toolbox, I tried to identify printed and handwritten fonts by prominent them on different sized grids. The first step is image attainment which gets the skimmed image followed by noise filtering, leveling and regularization of scanned image, translation image suitable for segmentation where image is decomposed into sub images. Feature Extraction improves recognition rate besides misclassification. The Artificial Neural Networks is trained using the Back Propagation algorithm. In the proposed Character recognition system, each typed English letter is characterized by binary numbers that are cast-off as input to a simple feature extraction system whose output, in addition to the input, are fed to an Artificial Neural Networks. Afterwards, the Feed Forward Algorithm gives insight into the enter workings of a neural network followed by the Back Propagation Algorithm which compromises Training, Error calculation, and Modifying Weights.

KEY WORDS: Character recognition (CR) , Artificial Neural Network, Back Propagation Algorithm, Feed Forward Algorithm, Image Acquisition**.**

INTRODUCTION

Character Recognition, usually referred to as CR, is the process of converting the image obtained by scanning a text or a document into machine editable format. Computer system equipped with CR system can improve the speed of input operation and decrease some possible human errors. Recognition of printed characters is itself a challenging problem since there is a variation of the same character due to change off on its or introduction of different types of noises. Difference in font and sizes makes recognition task difficult. If pre-processing, segmentation, feature extraction and recognition are not robust. There may be noise pixels that are introduced by scanning of the image. Besides, same size and font may also have bold face characters as well as normal one. Thus, width of the stroke is also a factor that affects character recognition. Therefore, a good character recognition approach must eliminate the noise after reading binary image data, smooth the image for better recognition, extract features efficiently, train the system and classify patterns. A lot of people today are trying to write their own CR (Character Recognition) System or to improve the quality of an existing one. This papers how show the use of artificial neural network simplifies development of a character recognition application, while achieving highest quality of recognition and good performance. CR system is a complicated task and requires a lot of effort. Such systems usually are really complicated and can hide a lot of logic. The use of artificial neural networking CR applications and improve quality of recognition while achieving good performance. There are two basic methods used for CR: Matrix matching and feature extraction. Of the two ways to recognize characters, matrix matching is the simpler and more common. Matrix Matching compares what the CR scanner sees as a character with a library of character matrices or templates. When an image matches one of these prescribed matrices of dots within a given level of similarity, the computer labels that image as the corresponding ASCII character. Feature Extraction is CR without strict matching to prescribed templates. Also known as Intelligent Character Recognition (ICR), or Topological Feature Analysis, this method varies by how much "computer intelligence" is applied by the manufacturer. The computer looks for general features such as open areas, closed

shapes, diagonal lines, line intersections, etc. This method is much more versatile than matrix matching.

STRUCTURE OF CHARACTER RECOGNITION SYSTEM

CR is the acronym for Character Recognition. This technology allows a machine to automatically recognize characters through an optical mechanism. Human beings recognize many objects in this manner our eyes are the "optical mechanism." But while the brain "sees" the input, the ability to comprehend these signals varies in each person according to many factors. The human brain is adaptive to minor changes and errors in visual patterns. Thus we are able to read the handwritings of many people despite different styles of writing. The human vision system learns from experience, Hence we are able to grasp newer styles and scripts with amazingly high speed. The human vision system is immune to most variations of size, aspect ratio, color, location and orientation of visual characters. By reviewing these variables, we can understand the challenges faced by the technologist developing a CR [1] system. The ultimate objective of any CR system is to simulate the human reading capabilities so the computer can read, understand, edit and do similar activities it does with the text.

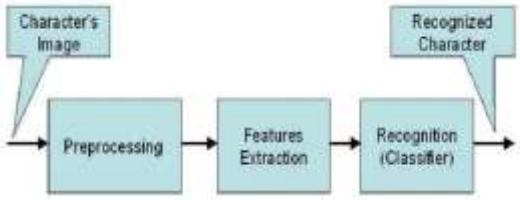

Fig 1. Character Recognition System Fig. 1 shows block diagram of the typical CR system. Each stage has its own problems and effects on the overall system's efficiency. Thus, to tackle the problems, either by solving each particular problem. CR system by integrating all stages to one main stage, and this is what our research proposes. This paper presents new structure of CR system which relies on
the powerful proprieties. The algorithm is designed and tested in the related sections.

COMPONENTS OF CR SYSTEM

Optical Scanning

Through the scanning process an image of the original document is captured. In CR optical scanners are used, which generally consist of a transport mechanism and a sensing device that converts light intensity into gray- levels. Printed documents usually consist of black print on a white background. The image should have a specific format such as JPEG, BMT etc. This image is acquired through a scanner, digital camera or any other suitable digital input device [3][4].

Segmentation

In the segmentation stage, an image of sequence of characters is decomposed into sub-images of individual character [6]. Segmentation is a process that determines the constituents of an image. It is necessary to locate the regions of the document where data have been printed and distinguish them from figures and graphics.

Pre-processing

The image resulting from the scanning process may contain a certain amount of noise. Depending on the resolution on the scanner and the success of the applied technique for thresholding, the characters may be smeared or broken. Some of these defects, which may later cause poor recognition rates, can be eliminated by using a pre-processor to smooth the digitized characters. The pre-processing also defines a compact representation of the pattern. Binarization process converts a gray scale image into a binary image [7]. Dilation of edges in the binarized image is done using sobel technique.

Feature extraction

The objective of feature extraction is to capture the essential characteristics of the symbols, and it is generally accepted that this is one of the most difficultproblems of pattern recognition .The most straightforward way of describing a character is by the actual raster image. Another approach is to extract certain features that still characterize the symbols, but leaves out the unimportant attributes. In this stage, the features of the characters that are crucial for classifying them at recognition stage are extracted. This is an important stage as its effective functioning improves the recognition rate and reduces the misclassification. Diagonal feature extraction scheme for recognizing handwritten characters is proposed in this work [5][6].

Post processing

Post-processing stage is the final stage of the proposed recognition system. It prints the corresponding recognized characters in the structured text form by calculating equivalent ASCII value using recognition index of the test samples.

ARTIFICIAL NEURAL NETWORK

A neural network is a powerful data modeling too that is able to capture and represent complex input/output relationships. The motivation for the development of neural network technology stemmed from the desire to develop an artificial system that could perform "intelligent" tasks similar to those performed by the human brain. Neural networks [2] resemble the human brain in the following two ways:

1. An Artificial neural network acquiresknowledge through learning.
2. An artificial neural network's

knowledge is stored within inter-neuron connection strengths known as synaptic weights.

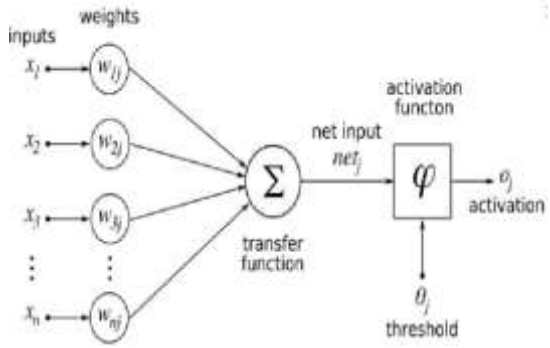

Fig 2. Structure of artificial neural network

BACK PROPAGATION ALGORITHM

The back-propagation algorithm consists of four steps:

- Compute how fast the error changes as the activity of an output unit is changed. This error derivative (EA) is the difference between the actual and the desired activity.

$$EA_j = \frac{\partial E}{\partial y_j} = y_j - d_j$$

- Compute how fast the error changes as the total input received by an output unit is changed .This quantity (EI) is the answer from step1 multiplied by the rate at which the output of a unit changes as its total input is changed.

$$EI_j = \frac{\partial E}{\partial x_j} = \frac{\partial E}{\partial y_j} \times \frac{dy_j}{dx_j} = EA_j y_j (1 - y_j)$$

- Compute how fast the error changes as a weight on the connection into an output unit is changed. This quantity (EW) is the answer from step2 multiplied by the activity level of the unit.

$$EW_{ij} = \frac{\partial E}{\partial W_{ij}} = \frac{\partial E}{\partial x_j} \times \frac{\partial x_j}{\partial W_{ij}} = EI_j y_i$$

- Compute how fast the error changes as the activity of a unit in the previous layer is changed .This crucial step allows back propagation to be applied to multilayer networks. When the activity of a unit in the previous layer changes, it affects the activities of all the output units to which it is connected .So to compute overall effect on the error, add together all these separate effects on output units . But each effect is simple to calculate. It is the answer in step2 multiplied by the weight on the connection to that output unit.

$$EA_i = \frac{\partial E}{\partial y_i} = \sum_j \frac{\partial E}{\partial x_j} \times \frac{\partial x_j}{\partial y_i} = \sum_j EI_j W_{ij}$$

By using steps 2 and 4, we can convert the EAs of one layer of units into EAs for the previous layer. The procedure can be repeated to get the EAs for as many previous layers as desired. Once we know the EA of a unit, we can use steps 2 and 3 to compute the EWs on its incoming connections.

5. CONCLUSION

Artificial neural networks are commonly used to perform character recognition due to high noise tolerance. The systems have the ability to yield good results. The feature extraction step of character recognition is the most important. A poorly chosen set of features will yield poor classification rates by any artificial neural network. At current stage of development, the software does perform well either in terms of speed or accuracy but not better. A simple approach for recognition of Optical characters using artificial neural networks has been described.

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