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OBJECT RECOGNITION AND SHAPE MATCHING USING NEURAL NETWORKS - A REVIEW

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Abstract: Digital Image Processing is a rapidly evolving field with growing applications in science and engineering. Object recognition and shape matching is evaluated by the image processing and pattern recognition techniques. Object recognition is the challenging problem in the real world application. The process of recognizing handwriting digits from pixel information falls into a field of artificial intelligence called pattern or image recognition. More techniques for pattern and image classification make use of neural networks. This implements such a neural network in order to learn to recognize general features of hand-written digits. The trained network can then be fed new inputs and then it attempts to recognize and categorize the image. The MNIST hand written digits, Coil Dataset, Gesture and Marine are used in the MATLAB neural network toolbox.

Keywords— Keywords: Digit recognition, MNIST Data base, Neural Networks.

1. INTRODUCTION

Object Recognition in real time systems is a complex problem and it is one of the common problem featured in computer vision applications. Shape matching is an important ingredient in shape retrieval, recognition and classification. The shape matching begins with the image processing. The steps involved in the shape matching such as image acquisition, preprocessing are done with the help of image processing techniques. The morphological operation in image processing plays a vital role in the shape matching, object recognition and it is a tool for extracting image description of region.

The process of identifying objects in images is called Pattern Recognition (PR). Pattern means archetype or prototype based on the objects formed. Identification is the act of assigning an object to the class patterns that belongs to. It can be called as Pattern identification. It is one of the key techniques used in Artificial Intelligence (AI) is concerned with problem solving.

The pattern recognition and the image processing are interrelated. The main application areas are Optical Character Recognition (OCR), Medical imagery and medical diagnosis, automation of aerial and satellite photo interpretation, industrial automation and inspection and model based recognition to detect defects in integrated circuits.

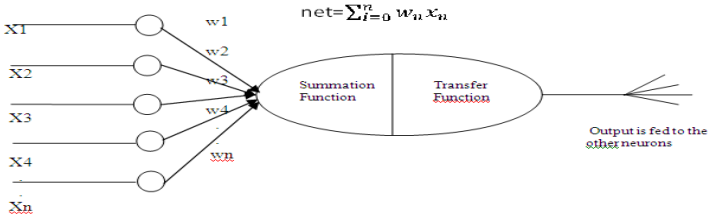

Figure 1.1 A single neuron

An Artificial Neural Network (ANN) is a system composed by multiple layers of simple processing elements called neurons (Figure 1.1).

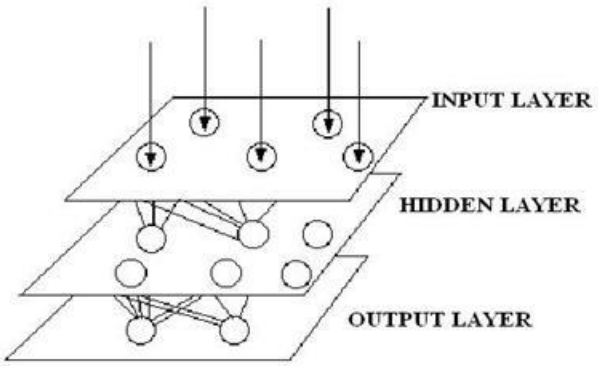

Figure 1.2: General scheme of a Multilayer Neural Network

Each neuron is linked to certain of its neighbors with
varying coefficients of connectivity (Figure 1.1). Each input is multiplied by a connection weight. In the simplest case these products are simply summed fed through a transfer function to generate a result and then output. Basically, all artificial neural networks have a similar topological structure.

Some of the neurons interface the real world to receive inputs and other neurons provide the real world with the network outputs. All the rest of the neurons are hidden as shown in figure1.2. The neurons are grouped into layers. The input layer consists of neurons that receive inputs form the external environment. The output layer consists of neurons that communicate the output of the system to the user or to the external environment. There are usually a number of hidden layers between these two layers. Once the input layer receives the input its neurons produce outputs and it becomes the inputs to the next layer of the system. The process continues until the output layer is invoked, providing its output to the external environment.

One of the most important effects the field of Cognitive Science can have on the field of Computer Science is the development of technologies that make tools more human. A very relevant present-day field of natural interface research is hand writing recognition technology. Some of the s based on the handwritten digit recognition using neural networks is discussed in forthcoming sections.

2. OBJECT RECOGNITION USING NEURAL NETWORKS

A back-propagation neural network with one hidden layer was used to create an adaptive character recognition system. Adaptive character recognition system created by neural networks is developed by Alexander J. Faaborg [1]. The system was trained and evaluated with printed text as well as several different forms of handwriting provided by both male and female participants. Despite variations in character size, orientation and position the neural network was able to recognize many of the characters. But 65% accuracy is still far below the 97% users demand, 2D image recognition is only part of the solution neural networks can bring to handwriting recognition.

Shape context presented by Belongie [2] is a novel approach in that the similarity between shapes is measured and used it for object recognition. The measurement of similarity is done by solving for correspondences between the shapes. The shape context at a reference point captures the remaining points relative to its character. Corresponding points on two similar shapes

will have similar contexts. By using the transformation, matching between the two shapes is performed. The dissimilarity between the two shapes is given by sum of matching errors between corresponding points and the results are presented for silhouettes, handwritten and coil data sets.

Thin Plate Spline (TPS) is an effective tool modeled by Bookstein [3] for modeling coordinate transformation in several computer vision applications. One drawback of this method is that it does not allow for principal warp analysis. By means of experiments on real and synthetic data, the pros and cons of different approximations are demonstrated so as to take decision suited for application.

The application of neural networks to the problem of identifying machine printed characters in an automated manner is developed by Eric W. Brown [4]. In this method a back propagation net is trained on the data consists of three eighty-four character fonts. The character resolution for all three fonts is 8X8. The sets contain upper and lower case letters as well as numbers and a handful of miscellaneous punctuation marks. The basic idea is to essentially run the identical data through the two different algorithms and note the differences in each run along the way.

Active Shape Model (ASM) is a robust approach to recognize and locate known rigid objects in the presence of noise, clutter and occlusion. It is more problematic to apply model based method to images. Cootes [5] describes a method for building models by learning patterns of variability from a training set of correctly annotated images and this can be used for image search in an iterative refinement algorithm that employed by Active Shape Models.

Handwritten digit recognition using back-propagation networks [6] developed by requires minimal preprocessing and architecture of the network was highly constrained and specifically designed for the task. The input of the network consists of normalized images of isolated digits. The main objective in this method is to show that large back-propagation (BP) networks can be applied to real image-recognition problems without a large, complex preprocessing stage.

Evolving Neural Networks using Moment Method for Handwritten Digit Recognition developed by H. El Fadili [7] proposes a neural network weights and topology optimization using genetic evolution and the back propagation training algorithm. This technique is applied and tested on the well known MNIST database of handwritten digits. Multilayer Feed Forward Neural Network (MFNN) is used to classify the patterns.

Reducing the Dimensionality of Data with Neural Networks developed by G. E. Hinton [8] is a method used for converting high-dimensional data into low-dimensional codes by training a multilayer neural network with a small central layer to reconstruct high-dimensional input vectors. Gradient descent can be used for fine-tuning the weights in the auto encoder networks. This method works well only if the initial weights are close to a good solution. This is an effective way of initializing the weights that allows deep auto encoder networks to learn low-dimensional codes that work much better than principal components analysis as a tool to reduce the dimensionality of data. But it is difficult to optimize the weights in nonlinear auto encoders that have multiple hidden layers (2-4). With large initial weights auto encoders typically find poor local minima with small initial weights, the gradients in the early layers are tiny. But finding such initial weights requires a very different type of algorithm that learns one layer of features at a time. The pretraining procedure for binary data is introduced to generalize it to real-valued data and proved that it works well for a variety of data sets. To speed up the pre training of each RBM subdivided all datasets in mini-batches, each containing 100 data vectors and updated the weights after each mini-batch.

Contour flexibility is a technique developed by Jianzhuang Liu [9]. This method discusses a novel shape descriptor of planar contour called contour flexibility that depicts the deformable potential at each point along a curve. It shows that the local and global features can be extracted by this shape descriptor. The author tested the results with the MPEG 7 database and produced a resultant score of about 89.31 % and for the shape context it gives the result of about 76.51%.

Hand Gesture Recognition Using Neural Networks developed by Klimis Symeonidis [10] observed that a pattern recognition system uses a transform that converts an image into a feature vector and it is compared with the feature vectors of a training set of gestures and finally the system will be implemented with a Perceptron network. Computer recognition of hand gestures may provide a more natural computer interface allowing people to point or rotate a CAD model by rotating their hands. Hand gestures can be classified in two categories: static and dynamic. A static gesture is a particular hand configuration and pose is represented by a single image. A dynamic gesture is a moving gesture represented by a sequence of images.

A Neural Network based recognition scheme for the classification of industrial components developed by A.R.Mcnei1 [11]. This approach is used for representing the silhouettes of industrial components by generating a vector sequence of Euclidean distances between the shape centroid and each boundary pixel. The sequence can be re-sampled to form a suitable input vector for an Artificial Neural Network (ANN). Three different types of ANN topologies like Multi-Layer Perceptron (MLP), a Learning Vector Quantization network (LVQ) and Hybrid Self Organizing Map (SOM) have been implemented. This method of representing industrial components has been used to compare the ANN architectures while implemented as classifiers

based on shape and dimensional tolerance. This method is experimented using various image sets to form training and test sets for the ANNs. Training and test sets included images of each one in different translations, rotation and scale. The networks were trained and assessed on its classification capabilities

A method of recognizing handwritten digits developed by Michael Revow [12] is by fitting generative models that are built from deformable B-splines with Gaussian ink generators spaced along the length of the spline. The splines are adjusted using a novel elastic matching procedure based on the Expectation Maximization (EM) algorithm that maximizes the likelihood of the model generating the data. This approach has many advantages. The method involves a relatively small number of parameters and hence training is relatively easy and fast. Compared to other recognition schemes it does not rely on some form of pre-normalization of input images, but handles arbitrary scalings, translations and a limited degree of image rotation. The main disadvantage of the method is it requires much more computation than the standard Optical Character Recognition (OCR) techniques.

Handwritten character recognition using multiscale Neural Network Training is a technique developed by Velappa Ganapathy [15]. This approach uses the multiscale neural training with modifications in the input training vectors for acquiring its advantage in training higher resolution character images. The selective thresholding uses the minimum distance technique to increase the level of accuracy of character recognition. This suggests that if the resolution of the character images grows larger neural network training tends to be slow due to more processing for larger input matrix and vice versa for lower resolution images. The multiscale training technique is used for optimizing the parameters with modifications in input vectors. This will provide faster training.

Neural Network approach to a classic Image Recognition Problem developed by Wilson Harron . This approach is carried out by splitting the image into a number of sub images, selecting random training images, training the neural networks and passing the whole set of puzzles through the image to find the character Waldo. The first task is to go through all of the puzzles and determine the centre point location in the puzzle. This task was done manually and the centre points were chosen as a point centered in Waldo's chest. It has experimented and it produce the results for the feed forward back propagation network and the perceptron network and suggested that using neural networks for this problem been shown to be an effective method especially a feed forward back propagation network.

The feature extraction method was actually performed and the neural net method was implemented. The comparisons between the two methods were not influenced by unfair differences in the data or unbalanced procedures that would favour one method over the other. The neural net approach uses three separate steps. The first step simply translated the binary character data into a friendlier form. The second step took the output of the first and trained a back propagation network on it output all the resulting weights and general network information. The third step took the output of the second and created a network. Overall the results of this one had to be chosen over the other the results here would indicate that the feature extraction method using standard AI techniques for classification would be the better choice.

These existing methods are applied for 2D images and limited 3D images only.

3. CONCLUSION AND FUTURE SCOPE

This paper may give the efficient method for finding the class of the hand written images. This method is simple and the invariant to the noise. This paper can also be extended to the hand written characters, industrial objects, face recognition and pedestrian identification.

The different type of neural networks can be used for the better performance. Some type's networks like RBF networks, Multilayer perceptrons (MLP) recurrent networks, self organized networks and pruning networks can also be used.

The Neural object recognition can be extended to recognize multiple objects from the images and it can be applied for Marine, Gesture, Kimia and Coil data sets. It can improve the reliability of the real time system. The algorithm can also be applied for the video image and aerial images to identify the object. The proposed method can be developed for different applications like image retrieval, military areas, investigation departments and industrial automation.

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