A Review on Pattern Recognition Techniques and Applications

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Abstract - This paper focuses on the three important techniques of pattern recognition such as the statistical method, the structural method and the neural method.The primary goal of pattern recognition is supervised or unsupervised classification. With the statistical method, analysis will be depends upon boundary of decisions which start up with feature space with the help of the statistically distributed pattern. Within structural method all the class patterns are described with the help of descriptions of structure.With the artificial neural networks method, artificial neural networks can form complex decision regions for pattern recognition. Extensive research is going on in the field of pattern recognition for more than two decades. [4][1].

Keywords – Pattern-recognition, dimensionality reduction, feature extraction, neural networks.

I. INTRODUCTION

Identifying and understanding the object and its surroundings is a difficult task. The Pattern Recognition technique used to solve problems in the field of voice recognitions, facial recognitions, handwriting classifications as well as disease diagnosis.Pattern recognitions techniques can be applied in different types of applications areas. The common thing found in all these applications is that features should be extracted from the object for the purpose of further analysis such as recognition and classification. The three type of process occurs in pattern recognition such as, Data acquisitions, data analysis and classifications. Thedata acquisitions method translates the data to different form. It is according to the type of devices used. The devices used are this task includes sensor, digitisation machines as well as scanners. Data analysis is the learning about the different data used, collecting information about different events happens, classes of pattern available in the data, these sorts of details are used for the further processing.In the classification a decision is made to categories the resultant data based on the experience gained in the data analysis step. The figure 1 shows the conventional system to recognize pattern.
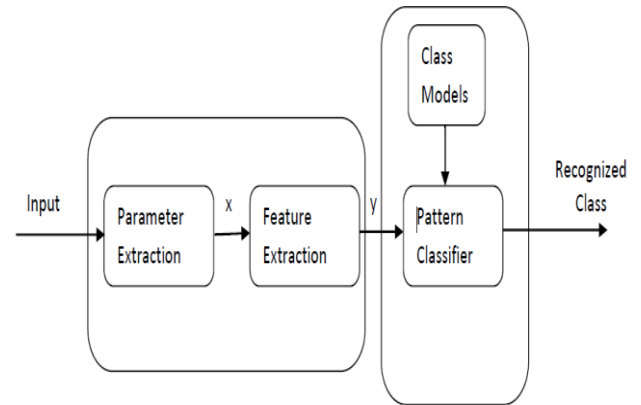

Figure1: Conventional pattern recognition model

The input data set supplied will be classified as two types called a set of training data as well as a set of testing data.Performance of the pattern recognition technique is generally based on the three elements, the quantity of data, technology utilized, the person who designs and the people who use. Challenge here is to design a system which has the ability of managing massive amounts of data [3].

II. PATTERN RECOGNITION MODELS

Frequently used pattern recognition techniques aretemplate matching, the statistical methods, the structural methods and artificial neural network methods.These models are not necessarily independent and sometimes the same pattern recognition method exists with different interpretations.

A. Template Matching - One of the simple and earliest approaches to pattern recognition is based on template matching.Matching is a generic operation in pattern recognition which is used to determine the similarity between two entities of the same type. Template matching has been performed at the pixel level and also on higher level.Advanced template matching algorithms allow finding the pattern occurrences regardless of their orientation and local brightness.

B. Statistical models - Statistical pattern recognition is based on the well-knownconcepts in the statistical decision theory, in order todistinguish data from different groups on the basis ofquantitative characteristics of the data.

The figure 2, represents the statistical model. There are different types statistical techniques have been used.
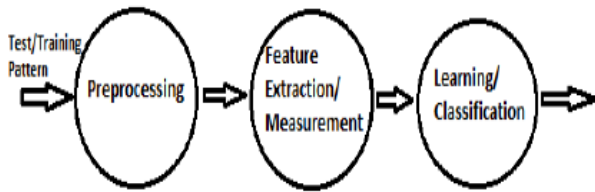

Figure 2: The Statistical model.

One such method is called as Discriminant Analysis. It is belongs to supervised technique which approaches the dimensionality reduction. In this approach the procedure used to classify is depends upon the statistical analysis. The patterns which are fall on the same class have statistically similar characteristics [5].

i). **Dimensionality Reduction method -** Dimensionality reduction of a dataset is very much essential. The dimensionality reduction is a method used to reduce the number of random variables and to get a set of principal variables. It is basically classified into feature selection and feature extraction. Feature selection means reducing number of features. Feature extraction means reducing number of patterns.The significant feature set which make the process of pattern representation and classification which are made on the chosen representation as simple. Ultimately, the resultant classifier may be fast and takes less memory. The classification algorithm performs well in the reduced space very much accurate than the original space [5].

ii). **Feature Extraction method -** This method is used to convert the high dimensional input into lower dimensions. The conversion method may be either linear or non linear. The feature extraction approach decides a suitable dimension m from the high dimensional space. The dimensionality may either linear or non linear. The most widely use best linear feature extraction method is principal component analysis method [5][3]. Feature extraction method will find out a subset of the original variables.From the given feature set, choose a small set with a size of m which results in minimum error of classification. For high features the following situations will come across. Multisensory fusion, the features which are calculated from the different sensors modalities can be combined to structure the feature vector contains more elements.Integration of multiple data method the data from the sensor will be designed by various methods, in which the design parameters act as features, the parameters of various designs will be joined to give a high-dimensional feature vector [5][3].

C. Structural (Syntactic) Model - For strong inherent structured input the statistical model yields ambiguous outputs. This is because of the process of feature extraction wipes out the critical information such as the basic structure.

So for complicated problems such as to recognize high dimensional input, the hierarchical pattern will be effective. In the hierarchical method the dimension will be divided into smaller dimensions. For the structural method the complicated pattern will be represented with set of simpler patterns along with the grammatical rule which indicates how these patterns are connected. The structural method tries to find out a pattern from its basic form. The language used for this purpose is pattern description language.The finite state automata will be applied to recognize finitestate languages. Comparing to finite state languages the context sensitive language will perform well. The context sensitive language will be defined by the non deterministic procedures. The choice of the grammar for pattern representation is based on the primitives, grammatical descriptive ability and analysis efficiency. The following figure (3) shows the syntactic pattern recognition method.
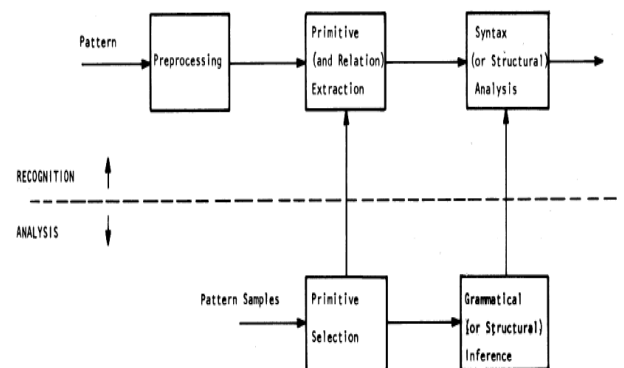

Figure 3: Syntactic pattern recognition system.

The high dimensions of pattern require high dimensions of grammar like the web grammar, the tree grammar, the graph grammar as well as the shape grammars of better representation. The stochastic languages, the approximation as well as transformation grammars will be used to represent the noisy as well as distorted pattern. This method requires large training sets as well as large computational efforts. If we deal with noisy pattern then the grammar used to define the basic structure for the complex patterns will be very difficult to represent, for this situations the statistical method can be used. The acceptance error can be used as criteria for measuring the performance. This method is find its usage in the areas such as textured objects, contour shape analysis as well as image interpretation in which the pattern use to have a exact structure [3][1][4].

D. Neural Pattern Recognition model - The neural network is the huge parallel structures consist of neurons like subunits. This method gives very good result for classification. The characteristics of changing its weight iteratively as well as learning lead this method more efficient than the other methods used to recognitions. The perceptron is the basic neuron mode, consists of 2 layers. In case if the output function is perceptron then it will carry out the problem of classifications. In case of linear output function then the regression problem may carry out. Most

common group of neural network is the feed forward network is themulti-layer perceptron (MLP). Based on the applications different types of neural network can be used [3][7][4].The Multi Layer Perceptron belongs to the feed forward neural network. The more flexible neural model is the McCulloch and Pitts model (MCP). It is shown in the figure (4). These are called as threshold logic units. The difference between the single layer model and to the inputs will be weighted. The effect of decision making may be based on the given inputweight.
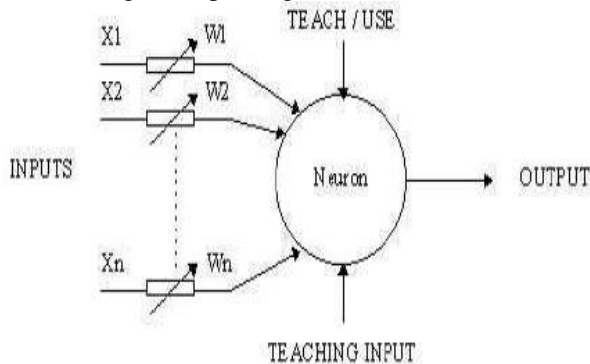

Figure 4: Multi-Layer Perceptron neuron system

The weighted input is obtained by multiplying the input with input number. These weighted inputs will be summed up. In case if the sum is becomes more than that of a pre set threshold then neuron will fire. For remaining cases neuron will not burn. It is represented mathematically in equation (1).

$$X1W1 + X2W2 + X3W3 + ... > T$$

… (1)

Summation of the input weights as well as the threshold will make the neuron a most flexible and powerful one.MCP neuron can be adapted with any situations just by changing its weight/threshold. There are number of algorithm exists that enables the neuron to be adaptable. The very commonly used one is Delta rule as well as the back error propagation. The first one will be used with feed forward network; the second one is used with feedback networks. The MLA utilises the supervised learning method. The MLP is the modified form the linear perceptron that will distinguish the data which is cannot be separated linearly. The figure 4 shows the Multi Layer Perceptron neuron system [7][3][4]. Generally two types of methods are used called supervised and un-supervisedclassification [1][3].

i). **Supervised learning -** The Supervised learning is the process of machine learning by understanding the method availablein the training data which are labelled. These data contains a group of examplewhich are trained. This method will assume that the training data sets will be provided, which consists of a set of instances which are correctly labelled by hand to the right output. Generally the supervised learning will be done on offline. The paradigms of the supervised

learning contains the learning techniques such as the error correcting learning, the rein for cement learning as well as the stochastic learning [7][5].

ii). **Unsupervised learning -** The unsupervised learning will assume that the input sets are un- labelled. It tries for searching inherent pattern from the input which is applied to find out right results for the new sets of values. The paradigms of unsupervised learning are the Hebbian learning as well as the competitive learning. The combination of these two is called as semi-supervised learning.Based on the technique applied, the pattern recognition methods are classified in to different types such as the statistical method, the structural method, the neural method [7][5]. In this method, every pattern will be described with d features. It also can be viewed, a small point of the d dimensional space. Objective of this method is to select feature which permit the feature vector belongs to various classes. The representational space efficiency will be decided on the performance of the classifier that is how well the various classes are spitted. After the feature vectors of all the classes are provided the next step is to create decision boundaries.

III. CONCLUSION

Different types of pattern recognition models are discussed. The major problems in pattern recognition system are the type of sensing environment, the representation of pattern, the extraction of features, the selection as well as the evaluation of performance. In case of noisy patterns, the statistical method will perform well. The importance of structural model is based on the recognition of pattern primitives as well as its relationships that can be described by descriptive language. When comparing with statistical method the structural method is a new research field. In case if the pattern is very complex then better to represent all the patterns with respect to its elements. The better choice of the grammar will increase the effectiveness of computation of the recognition system. Pattern primitives as well as the pattern grammar will be used based on the application. The minimal dependency, the previous experience, the accessibility of the effective learning algorithm makes the neural network popular in the area of pattern recognition.Even though the neural network and the statistical method are different in their principles they have some similarity as well. All the methods have their own advantages as well as disadvantages. To improve the performance of the complex applications it is better to use the combination of methods in different stages of recognition process [3][4][5][1].

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