Research Article

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Pattern Recognition Techniques

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ABSTRACT

Pattern recognition has emerged as one of the most popular research domain in various fields. Pattern recognition is classifying the input data into classes based on the features of the pattern. Main applications are artificial intelligence, data mining, web searching, Optical character recognition, face recognition, handwritten recognition etc.. The components of this technique include acquisition by sensors, feature extraction, preprocessing and classification .Various algorithm such as statistical, structural, neural networks, fuzzy sets and template matching are available for pattern recognition. Emerging technologies such as data mining, data analytics requires efficient pattern recognition techniques. The main aim of this paper is to compare the main aspects and methods of pattern recognition.

Keywords: Neural networks; Statistical approach; Supervised and unsupervised classification; Syntatctic approach; Template matching.

1. INTRODUCTION

Pattern may be a fingerprint image, handwritten word, speech signal, human face etc. This technique was used for automatically classifying physical objects. Pattern recognition deals with speech, face recognition, classification of handwritten characters, bioinformatics image analysis. In all these applications the process is common solution finding approach. Features need to be extracted, then recognition and classification need to be done based on the features. The origin of pattern recognition is seen on biological evolution, human can observe and sense the environment, based on the pattern, actions are taken. This is human perception. e.g., recognizing face, understanding handwriting etc. Pattern recognition was related to human perception. Patterns are represented as vectors of real numbers, attributes.

Pattern recognition synonyms with machine learning is the study of how machines can observe the environment, from the background patterns of interest should be extracted, then making decisions about the category of the pattern..It is different from pattern matching which looks for exact matches. The terms pattern recognition, data mining, machine learning and knowledge discovery in databases overlap each other. They all are originated from artificial intelligence. Patterns from different classes have different representations the primary goal of this technique was supervised and unsupervised Classification. Supervised classification the trained data are available. In unsupervised no such data available depended algorithm is used .Pattern recognition systems design should consider the three steps. One is data acquisition, data analysis and classification of the data.

1.1 Concept of Pattern Recognition

Data Acqusition by Sensors: Measurement of physical variable need to be done. Sensor is a device which converts physical quantity to be measured into a signal which can be read displayed stored and used. Important things are bandwidth, resolution, latency, sensitivity, distortion etc. Sensor is a device to sense the actual physical object and output a representation for processing by a machine. For example classifying fruits in the supermarket we could use a color camera to capture the shape color and texture features.

Preprocessing: In this process noise in the data can be cleared. The patterns of interest can be isolated from the background. In text recognition, preprocessing adds many steps to make the document available for the next stage. The input is plain text document, the output is set of tokens for the vector modeling this stage. For example recursive words are eliminated from the document, stop words are removed.

Extraction of Features: Measurements and their relations need to be extracted for the next stage of pattern recognition. Patterns are represented in basis of features. This process includes prior information, domain dependence, and discriminative features such as similar values for similar patterns. When the input is huge, it can be shorted as set of features. This process is called feature selection. Various feature extraction algorithms are available for this process. When multiple features are given decision boundaries can be applied. It is different from feature selection methods.

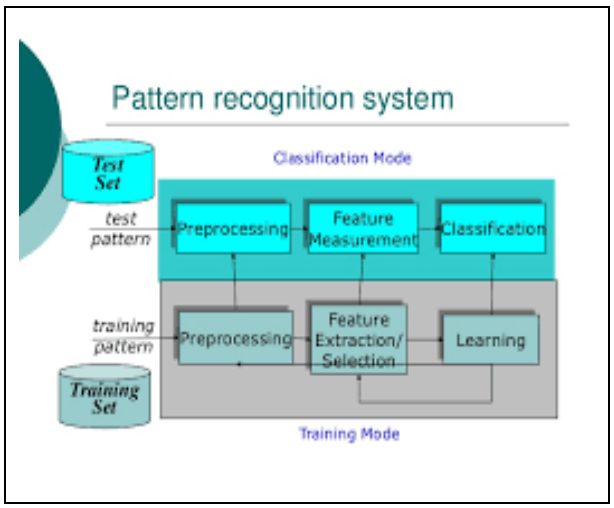

Fig. 1.1: Pattern recognition.

Classification: Class is a group of objects having some same properties. It is denoted by class label. A classifier is a device or algorithm which takes inputs as object representation and outputs a class label. Classification is the process of assigning label to an object according to some representation of the objects properties.

Post Processing and Decision Making: Context exploitation was done to improve the performance. Post processing considers the cost of action. This process minimizes classification error rate and the risk. In this method any recursive data in the features are eliminated which in turn minimizes the risk in the process by reviewing the whole features or vectors. Features are evaluated based on the correctness.

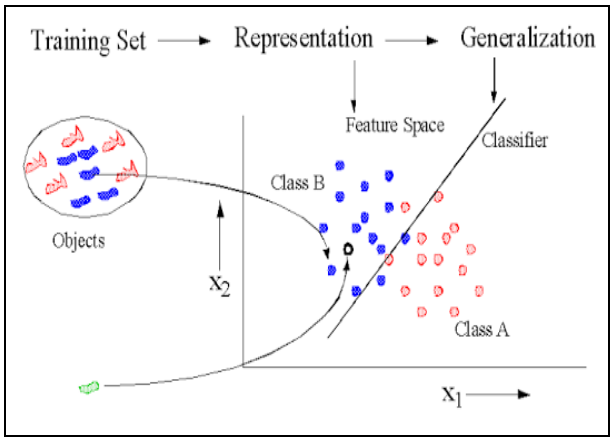

Fig. 1.2: Classification.

1.2 Supervised vs Unsupervised Patterns

The result of pattern recognition will be either supervised or unsupervised classification. Unsupervised classification refers to describe the hidden data from the unlabelled data. Unsupervised process is similar to the density estimation in statistics. In this classification different type of algorithms or techniques is used to describe the features of the data supervised classification can be achieved from the available training data (labeled). In unsupervised method there is no such trained data. Knowledge discovery databases and data mining were fully based on unsupervised methods, where as machine learning adopts supervised methods. In supervised method the giving training data is used to learn the description of classes and for labeling a new pattern. Clustering methods are unsupervised generic label is assigned to the group with same properties.

2. STATISTICAL APPROACH

In this method patterns are represented as d-features, each pattern is viewed as point in the feature space. A pattern from individual classes is separated in the feature space. For this separation decision boundaries are generated. Probability distribution of the features determines the decision boundaries. This method operates in two divisions, one is training another one is testing. In the first division features extraction algorithms finds the appropriate patterns. And they are represented in the feature space. The classifier separates the feature space by establishing decisions boundaries between them. In the testing division, the classifier which is now trained assigns the input pattern to pattern classes based on the features and measures. The decision making process in the method is mentioned a below:

1. Given pattern is assigned to anyone of the c categories w1, w2…we based on d attributes x=(x1, x2….ad).
2. The pattern vector of class wi is viewed by probability function p(x/wi)
3. To define the decision boundaries decision rues such as Bayes rules, maximum likelihood rule are used.
4. The classifier can be designed based on similarity of the features.

At the earliest period, statistical approach was mainly based on Bayesian decision rule and its various derivatives density estimation and error estimation. Most of the data mining algorithms are probabilistic in nature. The probabilities of the vectors need to be found the best feature vector is selected based on the probability

3. SYNTACTIC APPROACH

Hierarchical perspective of the pattern is adopted. Here, a pattern is viewed as being composed of sub patterns. The sub patterns to be recognized are called primitives are established. The pattern is viewed as sentence corresponding to a language, where as primitives are the alphabet, sentences are generated according to the grammer. Selection of grammar for pattern was based on primitives and the grammars description power and analysis efficiency. This approach

can be used in problems such as definite structure (EKG waveforms, shape analysis of contours etc).Producing classification was depend on similarities in pattern. After preprocessing the pattern is divided into sub patterns and primitives. Each primitives are associated with the particular constraints or grammatical rules.

4. TEMPLATE MATCHING

Similarity between two samples, pixels or cures is determined. The pattern to be recognized is matched with the available stored template. This technique is mainly suitable for image processing. Advance template matching algorithms are available for identifying templates. Some of the examples are naive's template matching, image correlation. Template matching can be accomplished with pixel level and high level. Pixel level there is many considerations such as total template, partial template, partial template and flexible template. Templates are described in terms of relations between the regions. This technique works only for isolated letters and simple objects. Each word is shown as template. Some of the applications of this method are speaker verification, word spotter application etc .This method is one of the earliest and simplest than the others.

5. NEURAL NETWORKS

Neural networks are the collection of neural like subunits neurons are the nodes and connections between them states the weight. This model inhibits the architecture of brain connected by neurons and axons. Perception is the neuron model. It consists of input, hidden and output layer. The output layer performs the classification. The hidden layer can be extended up to the length of the complex problem. Any algorithm can be fit into the architecture. This model becomes more efficient when increased no of neurons in the hidden layers is done in the system. Input pattern is detected then its associated output becomes the corresponding input. When a pattern that has no output associated with it, is given output with at least different from the given pattern. Some of the applications of the neural networks are sales forecasting, industrial process risk management data validation etc.

Some the neural networks are FFBP feed forward back propagation network used for nonlinear differentiate function) General Regression Neural Networks (for noisy data) are available for complex problems. A trained neural network is an "expect" in the group of information it has been given to analysis. Advantages of these techniques are adaptive learning self-origination, real time operation fault tolerance ability.

6. COMPARISON

Table1: Compared Issues

Statistical approach	Suitable for patterns with noises (applies statistical model).
Syntactic approach	Suitable for complex problems (solved as sub problems).
Template matching	Deals with images very well.
Neural networks	Adaptable for problems with nonlinear input and output relationship.

The syntactic approach need possibilities to be investigated demanding large training sets and computational efforts. Detecting primitives and the inference of grammer from the data may lead to difficulties. Template matching doesn't work well when the patterns are distorted. Statistical pattern may not be useful for realistic problems. Patterns that include structural or relational info are critical to decide as features. Syntactic approach can be used in situations where the patterns has definite and complex structures like ECG waveforms, shape analysis' of contours etc.

Neural networks have the ability to learn complex nonlinear input and output relationships which use sequential training procedures. In syntactic approach the implementations have to be considered with segmentation of noisy pattern and the inference of grammer from the training data. Fuzzy neural networks are employed to learn and extract rules in natural form. Template matching becomes too expensive and requires separate template for each scale.. In case of noisy patterns, choice of statistical model is a good solution.

7. LITERATURE REVIEW

Ripley (1996) stated the relationship between neural network and statistical approach in pattern recognition. Picard (1997) has identified a novel application of pattern recognition called affective computing which will give a computer the ability to recognize and express emotion, to suspend intelligent to human emotion, and to employ mechanism of emotion that contributes to rational decision making. L. R. Rabiner (1989) a tutorial on Hidden Markov Model and select applications in speech recognition", says Hidden Markov model is a statistical tool for modeling and recognizing sequenced data in particular speech data. Watanabe (1972) wrote in the preface of the book he edited, entitled Frontiers of Pattern Recognition, that Pattern Recognition is a fast-moving and proliferating discipline. It is not easy to form a well-balanced and well-

informed Summary view of the newest developments in this field.

8. CONCLUSION & FUTURE WORK

In this paper we reviewed pattern recognition techniques and comparative facts on these techniques. Different combination of these models can be used for problems in various domains. Lot of advancements can be made in various domain such as robotics, biometric identification etc. As each model has its own pros and cons, therefore to enhance system performance for complex problems it is necessary to append two or more recognition models at various stages of recognition process. Various analyses can be done in speech recognition using neural networks and statistical approach.

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CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

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