A SURVEY ON VARIOUS PATTERN RECOGNITION METHODS FOR THE IDENTIFICATION OF A DIFFERENT TYPES OF IMAGES

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ABSTRACT
The main aim of this paper is to discuss and compare some aspect of pattern recognition, and identify research topics and applications which are at the forefront of this exciting and challenging field. The primary goal of pattern recognition is supervised or unsupervised classification. More recently, neural network techniques and methods imported from statistical learning theory have been receiving increasing attention. The design of a recognition system requires careful attention to the following issues: definition of pattern classes, sensing environment, pattern representation, feature extraction and selection, classifier design and learning, selection of training and test samples and performance evaluation. In the area of research and development in this field, the general problem of recognizing complex patterns with arbitrary orientation, location, and scale remains unsolved. New and emerging applications, such as data mining, web searching, retrieval of multimedia data, face recognition, and cursive handwriting recognition, require robust and efficient pattern recognition techniques.

Keywords: pattern recognition, classification, feature extraction, neural networks.

I. INTRODUCTION
Human problem solving is basically a pattern processing problem and not a data processing problem. In any pattern recognition task humans perceive patterns in the input data and manipulate the pattern directly. In this paper we discuss computing models based on artificial neural networks (ANN) to deal with various pattern recognition situations in real life. Pattern recognition is a branch of science that helps develop “classifiers” that can recognize unknown instances of objects. In this context, to recognize an object means to classify it, or to assign it to one of a set of possible classes or labels. This class assignment of objects is based on an analysis of the values of one or more features of the object. Pattern recognition techniques are used in a wide variety of commercial applications. Common examples include character recognition, such as the scanning of a printed page of text into a word processor; natural language recognition, such as using voice commands to relay a set of possible responses to a computer system over the phone; analysis of fingerprint, face or eye images in order to verify a person’s identity; analysis of images taken from airplanes or satellites, perhaps in order to detect and track oil spills in the ocean; or analysis of medical images in order to scan for abnormalities, such as cancer vs. normal tissue. The roots of pattern recognition can be found in biological evolution, since many of us humans can e.g.

- Spot hanging weather brains.
- Identify thousands of species (flowers, animals)
- Recognize faces and voices

In science and technology emerged literally thousands of pattern recognition tasks, like:

- Diagnosing diseases
- Identifying types of vehicles, planes
- Identifying fingerprints and DNA profiles
- Recognize handwritten characters and human voice

II. PATTERN RECOGNITION
A pattern “it is an entity that could be given a name”. For example, a pattern could be a fingerprint image, a handwritten cursive word, a human face, or a speech signal. Given a pattern, its recognition/classification may consist of one of the following two tasks: 1) Supervised classification (e.g., discriminant analysis) in which the input pattern is identified as a member of a predefined class, 2) Unsupervised classification e.g., clustering) in which the pattern is assigned to a unknown class. Note that the recognition problem here is being posed as a classification or categorization task, where the classes are either defined by the system designer (in supervised classification) or are learned based on the similarity of patterns (in unsupervised classification). Picard has identified a novel application of pattern recognition, called affective computing which will give a computer the ability to recognize and express emotions, to respond intelligently to human emotion, and to employ mechanisms of emotion that contribute to rational decision making. Recently a lot of area comes under pattern recognition due to emerging application which are not only challenging but also computationally more
demanding. A common characteristic of a number of these applications is that the available features are not usually suggested by domain experts, but must be extracted and optimized by data driven procedures. The four best known approaches for pattern recognition are:

A. Template matching,
B. Statistical classification,
C. Syntactic or structural matching, and
D. Neural networks.

These models are not necessarily independent and sometimes the same pattern recognition method exists with different interpretations.

**A. TEMPLATE MATCHING**

One of the simplest 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 (points, curves or shapes) of the same type. In template matching, a template (typically, a 2D shape) or a prototype of the pattern to be recognized is available. The pattern to be recognized is matched against the stored template while taking into account all allowable pose (translation and rotation) and scale changes. The similarity measure, often a correlation, may be optimized based on the available training set. Often, the template itself is learned from the training set. Template matching is computationally demanding, but the availability of faster processors has now made this approach more feasible. The rigid template matching mentioned above, while effective in some application domains, has a number of disadvantages. For instance, it would fail if the patterns are distorted due to the imaging process, viewpoint change, or large intra-class variations among the patterns.

**B. STATISTICAL APPROACH**

In the statistical approach, each pattern is represented in terms of d features or measurements and is viewed as a point in a d dimensional space. The goal is to choose those features that allow pattern vectors belonging to different categories to occupy compact and disjoint regions in a d-dimensional feature space. The effectiveness of the representation space (feature set) is determined by how well patterns from different classes can be separated. Given a set of training patterns from each class, the objective is to establish decision boundaries in the feature space which separate patterns belonging to different classes. In the statistical decision theoretic approach, the decision boundaries are determined by the probability distributions of the patterns belonging to each class, which must either be specified or learned. One can also take a discriminant analysis-based approach to classification: First a parametric form of the decision boundary (e.g., linear or quadratic) is specified; then the “best” decision boundary of the specified form is found based on the classification of training patterns. Such boundaries can be constructed using, for example, a mean squared error criterion. Statistical pattern recognition is shown in the following Fig1.

![Fig 1: Statistical Pattern Recognition System](image)

Statistical pattern recognition method, the classification algorithms based on statistical analysis. Patterns belonging to the same class, defined as a statistically have similar characteristics. In this method, a property characteristic measurements are described as examples of input pattern is removed. Each pattern is defined by a feature vector. In general, the decision by the classifier, and focuses on the importance of classification methods. Classifier design, measurements and pattern information can be processed like to combine the probabilities are based. Thus, classification, input data space based on the estimated probability density functions of a statistical structure.

Various strategies are utilized to design a classifier in statistical pattern recognition, depending on the kind of information available about the class-conditional densities.

**i. Dimensionality Reduction:**

There are two main reasons to keep the dimensionality of the pattern representation (i.e., the number of features) as small as possible: measurement cost and classification accuracy. A limited yet salient feature set simplifies both the pattern representation and the classifiers that are built on the selected representation. Consequently, the resulting classifier will be faster and will use less memory.

**ii. Feature Extraction:**

Feature extraction methods determine an appropriate subspace of dimensionality m (either in a linear or a nonlinear way) in the original feature space of dimensionality d (m=d). Linear transforms, such as principal component analysis, factor analysis, linear discriminant analysis, and projection pursuit have been widely used
in pattern recognition for feature extraction and dimensionality reduction. The best known linear feature extractor is the principal component analysis (PCA).

iii. Feature Selection:
The problem of feature selection is defined as follows: given a set of d features, select a subset of size m that leads to the smallest classification error. If a large number of features encountered in the following situations: 1) multi-sensor fusion: features, computed from different sensor modalities, are concatenated to form a feature vector with a large number of components 2) integration of multiple data models: sensor data can be modeled using different approaches, where the model parameters serve as features, and the parameters from different models can be pooled to yield a high-dimensional feature vector.

C. SYNTACTIC APPROACH
In many recognition problems involving complex patterns, it is more appropriate to adopt a hierarchical perspective where a pattern is viewed as being composed of simple sub patterns which are themselves built from yet simpler sub patterns. The simplest/elementary sub patterns to be recognized are called primitives and the given complex pattern is represented in terms of the interrelationships between these primitives. In syntactic pattern recognition, a formal analogy is drawn between the structure of patterns and the syntax of a language. The patterns are viewed as sentences belonging to a language, primitives are viewed as the alphabet of the language, and the sentences are generated according to a grammar. Thus, a large collection of complex patterns can be described by a small number of primitives and grammatical rules. The grammar for each pattern class must be inferred from the available training samples. Structural pattern recognition is intuitively appealing because, in addition to classification, this approach also provides a description of how the given pattern is constructed from the primitives. This paradigm has been used in situations where the patterns have a definite structure which can be captured in terms of a set of rules, such as waveforms, textured images, and shape analysis of contours. The implementation of a syntactic approach, however, leads to many difficulties which primarily have to do with the segmentation of noisy patterns (to detect the primitives) and the inference of the grammar from training data. The attributed grammars which unifies syntactic and statistical pattern recognition. The syntactic approach may yield a combinatorial explosion of possibilities to be investigated, demanding large training sets and very large computational efforts.

Structural (geometrical, the rule sequence) in the pattern recognition approach, a given pattern, formal structure to define the basic characteristic is reduced. Most of the time, the numerical values of the set features not only information extracted from patterns. Connected to each other or the mutual relationship between the features, to identify and classify information to facilitate major structural features. In other words, the pattern obtained from the raw state of descriptive identification with formal syntax or grammar from their synthesis occurs. For example, the pattern is the number of corner, edge angles, and so on. In general, the structural method is formulated in more simple sub-patterns to define complex hierarchical patterns. Structural method, each pattern, the components are treated as a composition. The following Fig 2 shows a structural pattern recognition system.

D. NEURAL NETWORKS
The pattern recognition approaches discussed so far are based on direct computation through machines. Direct computations are based on math-related techniques. The neural approach applies biological concepts to machines to recognize patterns. The outcome of this effort is invention of artificial neural networks. A neural network is an information processing system. It consists of massive simple processing units with a high degree of interconnection between each unit. The processing units work cooperatively with each other and achieve massive parallel distributed processing. The design and function of neural networks simulate some functionality of biological brains and neural systems. The advantages of neural networks are their adaptive-learning, self-organization and fault-tolerance capabilities. For these outstanding capabilities, neural networks are used for pattern recognition applications. Some of the best neural models are back-propagation, high-order nets, time-delay neural networks and recurrent nets. Normally, only feed-forward networks are used for pattern
recognition. Feed-forward means that there is no feedback to the input. Similar to the way that human beings learn from mistakes, neural networks also could learn from their mistakes by giving feedback to the input patterns. This kind of feedback would be used to reconstruct the input patterns and make them free from error; thus increasing the performance of the neural networks. Of course, it is very complex to construct such types of neural networks. These kinds of networks are called as auto associative neural networks. As the name implies, they use back-propagation algorithms. One of the main problems associated with back-propagation algorithms is local minima. In addition, neural networks have issues associated with learning speed, architecture selection, feature representation, modularity and scaling. Though there are problems and difficulties, the potential advantages of neural networks are vast.

III. CONCLUSION

A survey on the pattern recognition has been presented. It has been shown that powerful methods exist, however, care has to be taken to build robust and consistent classifiers. The best approach for the inexperienced user seems to be the use of classical statistical tools, since plug and play works in this case. Pattern recognition can be done both in normal computers and neural networks. Computers use conventional arithmetic algorithms to detect whether the given pattern matches an existing one. It is a straightforward method. It will say either yes or no. It does not tolerate noisy patterns. On the other hand, neural networks can tolerate noise and, if trained properly, will respond correctly for unknown patterns. Neural networks may not perform miracles, but if constructed with the proper architecture and trained correctly with good data, they will give amazing results, not only in pattern recognition but also in other scientific and commercial applications.

REFERENCES