

An Overview of Pattern Recognition and Approaches of it

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Abstract--Any object that we see in the world that forms a pattern whether it be an image of a car or speech signals like the word “yes” which produce an oscillating wave on oscilloscope. Pattern describe what we see in the world ,what we hear and what we sense. So the job of pattern recognition is a machine should be able to understand what we are seeing around us or what we are speaking. Pattern recognition is used to give human recognition intelligence to machine which is soul of today's many modern application. Pattern Recognition is recognition process which recognizes a pattern using a machine or computer. Researchers and scientists are evolved new pattern recognition techniques and apply them to many real life applications such as agriculture, robotics, biometrics, medical diagnosis, life form analysis, image processing, process control, information management systems, aerial photo interpretation, weather prediction, sensing of life on remote planets, behavior analysis, Speech recognition, automatic diseases detection system in the infected plants, cancer detection system etc. with combination of other technology

Keywords :- Approaches of pattern recognition, Data Acquisition, Pre Processing, Feature Extraction, Classification, Statistical pattern, Structural pattern.

INTRODUCTION

Pattern recognition is the branch of machine learning a computer science which deals with the regularities and patterns in the data that can further be used to classify and categorize the data with the help of Pattern Recognition System. In a typical pattern recognition application, the raw data is processed and converted into a form that is amenable for a machine to use. Pattern recognition involves classification and cluster of patterns. In classification, an appropriate class label is assigned to a pattern based on an abstraction that is generated using a set of training patterns or domain knowledge. Classification is used in supervised learning.

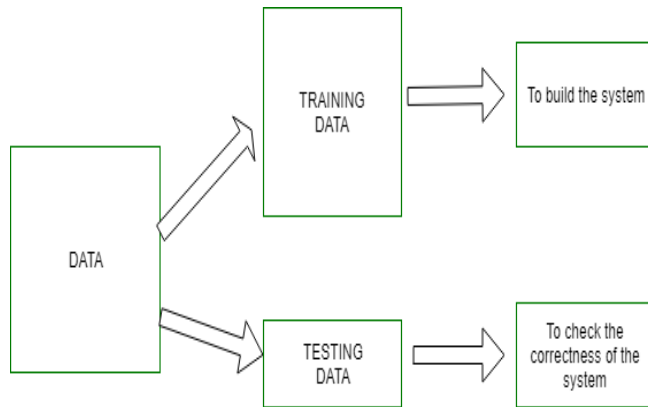
Clustering generated a partition of the data which helps decision making, the specific decision making activity of interest to us. Clustering is used in an unsupervised learning.

Training and Learning in Pattern Recognition:-

Learning is a phenomena through which a system gets trained and becomes adaptable to give result in an accurate manner. Entire dataset is divided into two categories, one which is used in training the model i.e. Training set and the other that is used in testing the model after training, i.e. Testing set.

Training set : Training set is used to build a model. It consists of the set of images which are used to train the system. Training rules and algorithms used to give relevant information on how to associate input data with output decision. The system is trained by applying these algorithms on the dataset, all the relevant information is extracted from the data and results are obtained.

Testing set: Testing data is used to test the system. It is the set of data which is used to verify whether the system is producing the correct output after being trained or not. Testing data is used to measure the accuracy of the system. Example: a system which identifies which category a particular flower belongs to, is able to identify seven category of flowers correctly out of ten and rest others wrong, then the accuracy is 70 %



Approaches to pattern recognition:-

There are two fundamental pattern recognition approaches for implementation of pattern recognition system. These are:

- Statistical Pattern Recognition Approaches.
- Structural Pattern Recognition Approaches

Statistical Pattern :

- Statistical Pattern Recognition Approach is in which results can be drawn out from established concepts in statistical decision theory in order to discriminate among data based upon quantitative features of the data from different groups. For example: Mean, Standard Deviation.
- The comparison of quantitative features is done among multiple groups.

1. Bayesian Decision Theory

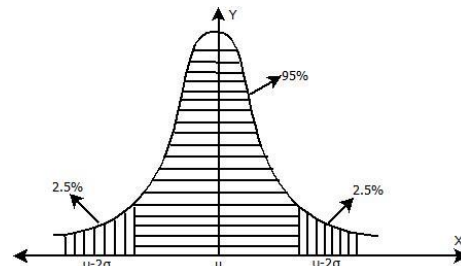
- Bayesian decision theory is a statistical model which is based upon the mathematical foundation for decision making.
- It involves probabilistic approach to generate decisions in order to minimize the complexity and risk while making the decisions.
- In Bayesian decision theory, it is assumed that all the respective

probabilities are known because the decision problem can be viewed in terms of probabilities.

- It can be said that, Bayesian decision theory is dependent upon the Baye’s rule and posterior probability needs to be calculated in order to make decisions with the knowledge of prior probability

2. Normal Density

- Normal density curve is a bell shaped curve which is the most commonly used probability density function.



Normal Density Curve:Pattern Recognition Approaches

- Since it is based upon the central limit theorem, normal density concept is able to handle larger number of cases.
- The Central Limit Theorem States that - “A given sufficiently large sample size from a population with a finite level of variance, the mean of all samples from the same population will be equal to mean of population”.

3. Discriminate Function

- Pattern Classifiers can be represented with the help of discriminate functions.
- Discriminate Functions are used to check, which continuous variable discriminates between two or more naturally occurring groups.

Structural Pattern:

we came across patterns with strong inherent structures, statistical methods give ambiguous results, because feature extraction destroys vital information concerning the basic structure of pattern. Therefore, in complex pattern recognition problems, like recognition of multidimensional objects it is preferred to adopt a hierarchical system, where a pattern is considered to be made up of simple sub-patterns, which are further composed of simpler sub patterns. In structural approach of pattern recognition a collection of complex patterns are described by a number of sub-patterns and the grammatical rules with which these sub patterns are associated with each other. This model is concerned with structure and attempts to recognize a pattern from its general form. The language which provides structural description of patterns in terms of pattern primitives and their composition is termed as pattern description language. Increased descriptive power of a language leads to increased complexity of syntax analysis system.

Advantages:-

- Pattern recognition solves classification problems
- Pattern recognition solves the problem of fake bio metric detection.
- It is useful for cloth pattern recognition for visually impaired blind people.
- It helps in speaker diarization.
- We can recognise particular object from different angle.

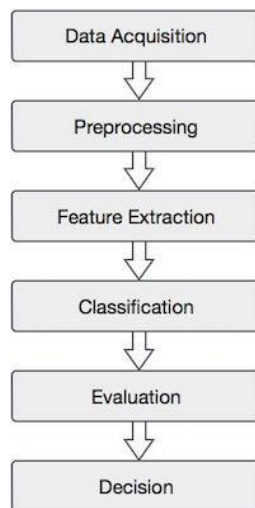
Applications:-

- **Image processing, segmentation and analysis**

Pattern recognition is used to give human recognition intelligence to machine which is required in image processing.

- **Computer vision :** Pattern recognition is used to extract meaningful features from given image/video samples and is used in computer vision for various applications like biological and biomedical imaging.
- **Seismic analysis:** Pattern recognition approach is used for the discovery, imaging and interpretation of temporal patterns in seismic array recordings. Statistical pattern recognition is implemented and used in different types of seismic analysis models.
- **Radar signal classification/analysis** Pattern recognition and Signal processing methods are used in various applications of radar signal classifications like AP mine detection and identification.
- **Speech recognition:** The greatest success in speech recognition has been obtained using pattern recognition paradigms. It is used in various algorithms of speech recognition which tries to avoid the problems of using a phoneme level of description and treats larger units such as words as pattern
- **Finger print identification** The fingerprint recognition technique is a dominant technology in the biometric market. A number of recognition methods have been used to perform fingerprint matching out of which pattern recognition approaches is widely used.

Component of Pattern Recognition:



Data Acquisition: The process consists of three major steps after data acquisition. Datasets for pattern recognition can be from a wide range of sources like satellite sensor data, ground based sensor data, medical images and so on. Once the dataset is acquired it is preprocessed, so that it is suitable for subsequent sub-processes.

Preprocessing: One of the most common preprocessing steps done in field of pattern recognition are normalization to zero mean and unit variance, especially for 1-D datasets. In the field of remote sensing most common preprocessing step required is re-gridding, which is basically assigning a spatio-temporally uniform grid to raw data. In many image processing applications, it is desirable to have a uniform spatial grid for the pattern recognition process.

Feature Extraction: The main goal of feature extraction is to reduce the data dimensionality and properly represent the original data in feature space. Features useful for classification process can be simple features like RGB values in color images, or complex features like energies from the Fourier Transform or Wavelet Transform of a time series. The feature extraction process usually consists of three steps

- a. Feature construction is the step in which features are constructed from linear or non-linear combination of raw features.
- b. Feature selection process is done using techniques like relevancy ranking of individual features.
- c. Feature reduction process is used to reduce the no. of features especially when too many features are selected compared to the no. of feature vectors.

Classification: The main goal of feature extraction is to reduce the data dimensionality and properly represent the original data in feature space. Features useful for classification process can be simple features like RGB values in color images, or complex features like energies from the Fourier Transform or Wavelet Transform of a time series. The feature extraction process usually consists of three steps 1) Feature construction is the step in which features are constructed from linear or non-linear combination of raw features. 2) feature selection process is done using techniques like relevancy ranking of individual features and 3) feature reduction process is used to reduce the no. of features especially when too many features are selected compared to the no. of feature vectors.

Conclusion:-

A comparative view of all the models of pattern recognition has been shown which depicts that for various domains in this areas different models or combination of models can be used. In case of noisy patterns, choice of statistical model is a good solution. Practical importance of structural model depends upon recognition of simple pattern primitives and their relationships represented by description language. As compared to statistical pattern recognition, structural pattern recognition is a newer area of research. For complex patterns and applications utilizing large number of pattern classes, it is beneficial to describe each pattern

in terms of its components. A wise decision regarding the selection of Pattern grammar influences computations efficiency of recognition system. Pattern primitives and pattern grammar to be utilized depends upon the application requirements. Low dependence of neural networks on prior knowledge and availability of efficient learning algorithms have made the neural networks famous in the field of Pattern Recognition. Although neural networks and statistical pattern recognition models have different principles most of the neural networks are similar to statistical pattern recognition models. To recognize unknown shapes fuzzy methods are good options. As each model has its own pros and cons, therefore to enhance system performance for complex applications it is beneficial to append two or more recognition models at various stages of recognition process.

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