A REVIEW ON PATTERN RECOGNITION

Mohinikanta Sahoo

Corresponding author: mk186.sahoo@gmail.com

Abstract: Pattern recognition is one of the most important functionalities for intelligent behavior and is displayed by both biological and artificial systems. In addition, pattern recognition systems are successful to the extent that they can continuously adapt and learn from examples; the underlying framework for building such systems is predictive learning. The pattern recognition problem is a special case of the more general problem of statistical regression; it seeks an approximating function that minimizes the probability of misclassification.

Keywords: artificial systems, predictive learning

1 Introduction

Pattern recognition is a branch of machine learning that focuses on the recognition of patterns and regularities in data. Pattern recognition is the assignment of a physical object or event to one of several pre-specified categories. A pattern can be an object, process or event. A set of patterns that share some common properties can be regarded as pattern class. During recognition or classification classes are assigned to the objects.
With the recent advances in computing technology, many pattern recognition tasks have become automated. Today useful applications of automatic pattern recognition are prevalent. These are fingerprint identity verification, video-based Surveillance, credit Screening, document classification etc.

2 Pattern recognition Tasks:

There are several pattern recognition tasks which human beings are able to perform very naturally and effortlessly.

2.1 Pattern Association:

Pattern association problem involves storing a set of patterns or a set of input-output pattern pairs in such a way that when test data are presented, the pattern or pattern pair corresponding to the data is recalled. It is desirable to recall the correct pattern even though the test data are noisy or incomplete. The problem of storage and recall of patterns is called auto association. It is also necessary to store as many patterns or pattern pairs as possible in a given system. Printed characters or any set of fixed symbols could be considered as examples of patterns for these tasks.

2.2 Pattern Mapping:

In pattern mapping, given a set of input patterns and the corresponding output pattern or class label, the objective is to capture the implicit relationship between the patterns and the output, so that when a test input is given, the corresponding output pattern or the class label is retrieved. Speech spectra of steady vowels generated by a person, or hand-printed characters, could be considered as examples of patterns for pattern mapping problems.

2.3 Pattern Grouping:

In this case, given a set of patterns, the problem is to identify the subset of patterns possessing similar distinct features and group them together. In the pattern mapping problem the patterns for each group are given separately, and the implicit, although distinct, features have to be captured through the mapping. In pattern grouping on the other hand, patterns belonging to several groups are given, and the system has to resolve the groups. Examples of the patterns for this task could be printed characters or hand-printed characters.

2.4 Feature Mapping:

In several patterns the features are not unambiguous. It is difficult to form groups of patterns having some distinct features. In such cases, it is desirable to display the feature changes in the patterns directly. In this case what is learnt is the feature map of a pattern and not the group or class to which the pattern may belong. This occurs, for example, in the speech spectra for vowels in continuous speech.

2.5 Pattern Variability:

There are many situations when the features in the pattern undergo unspecified distortions each time the pattern is generated by the system. This can be easily seen in the normal handwritten cursive script. Human beings are able to recognize them due to some implicit interrelations among the features. Classification of such patterns falls into the category of pattern variability task.

2.6 Temporal Patterns:

Human beings are able to capture effortlessly the dynamic features present in a sequence of patterns. This is true, for example, in speech where the changes in the resonance characteristics of the vocal tract system capture the significant information about the speech message. This is also true in any dynamic scene situation. All such situations require handling sequences of static patterns simultaneously, looking for changes in the features in the sub patterns in adjacent pattern pairs.

3 Steps in solving any Pattern Recognition Problem:

3.1 Data acquisition:

Data acquisition is the process of sampling signals that measure real world physical conditions and converting the resulting samples into digital numeric values that can be manipulated by a computer. Data acquisition systems typically convert analog waveforms into digital values for processing.

3.2 Data Preprocessing:

Data preprocessing converts raw data and signals into data representation suitable for application through a sequence of operations. Mainly, data preprocessing include contrast and background adjustment and segmentation of images.

3.3 Feature Extraction:

When the input data to an algorithm is too large to be processed and it is suspected to be redundant then it can be transformed into a reduced set of features (also named features vector). This process is called feature extraction. The extracted features are expected to contain the relevant information from the input data, so that the desired task can be performed by using this reduced representation instead of the complete initial data.

3.4 Classification Based On Feature Vectors:

After feature extraction, each pattern is a vector. Classification assign a category to the object based on the feature vector provided during feature extraction. Classifier is a function to map such vectors into class labels. For classification, there are numerous underlying objective functions that we can seek to optimize such as Minimum-error-rate Total expected cost or Risk minimization

4 Literature Survey

In the field of pattern recognition, many researchers have contributed a number of research papers varying the diversified applications. In this work, a mixed collection of research papers have been collected from various online database like Science direct, IEEE explore etc. The literature survey comprises of different works in the pattern recognition field starting from the year 2000 to 2015.

Jainet. al.(2000) have summarized and compared some of the well-known methods used in various stages of a pattern recognition system and identify research topics and applications [1].Masayuki et. al.(2001) have proposed a neuralnetwork model of the 2D invariant pattern recognition with eye movement[2].Menget. al.(2002)have proposed aneural network with Radial basis function(RBF) for face recognition[3]. Alsultannyet.

al.(2003) have proposed a neuralnetworkintegrated with the genetic algorithm for pattern recognition and the result showed good optimization[4].

Inoue et. al.(2003) have described the efficiency of self-generating neural networks applied to pattern recognition[5].Hanet. al.(2004) have proposed anew feed-forward neural network called radial basis perceptron (RBP) neural network forpattern recognition[6].Lianget. al.(2005) have proposed a back propagation neural networkof pattern recognition on scoring Chinese corporations financial conditions[7].Evgenyet. al.(2005) have proposed a modified high-order neural network for invariant pattern recognition which reduces computation time as well as memory requirements for network configuration and weight storage[8].

Shi et. al.(2006) have proposed a multi-module artificial neural network approach to pattern recognition with optimized nanostructured sensor array[9].Guobinet. al.(2007) have proposed a multi-class pattern classification using neural networks[10]. Nicolas et. al.(2007) have proposed a cooperative constructive method for neural networks for pattern recognition[11]. Zhang(2007) has proposed an artificial neural network based on principal component analysis(PCA) for clinical pattern recognition analysis[12].

K.ShantiSwarup(2008) has proposed an artificial neural network using pattern recognition for security assessment and analysis[13].Majewski et. al.(2009) have proposed an artificial neural network for sentence recognition[14]. Lin et. al.(2009) have proposed a recurrent neural-fuzzy network (RNFN) based on improved particle swarm optimization(PSO) for pattern recognition applications[15]. Balasubramanianet. al.(2009) have proposed a method for automatic real time face and mouth recognition using radial basis function(RBF) neural network[16].

Ghorpadeet. al.(2010) have illustrated a recognition system for human faces using a novel Kohonen self-organizing map (SOM) based retrieval system[17]. Jian-Da et. al.(2011) have proposed a support vector machine (SVM) technique for finger-vein pattern identification in a personal identification system[18]. Lukmanet. al.(2011) have proposed an automatic recognition of oral vowels in tone language using ANN model and fuzzy logic[19]. GuoXianhai(2011) has proposed the emotional pattern recognition method based on ECG and RBF neural network[20].

Micheloniet. al.(2012) have proposed abalanced neural tree for pattern classification[21].Kumaret. al.(2013) have proposed aHopfield neural network with sub-optimal and random GA for pattern recalling of English characters[22]. Mazinet. al.(2013) have proposed a method for hand written digits recognition using digital learning networks.Kasabovet. al.(2014) have proposed a dynamic evolving spiking neural networks for on-line spatio- and spectro-temporal pattern recognition.Buscemaet. al.(2015) have proposed anew artificial neural networkK-CM for supervised pattern recognition.

5 Conclusion and Future Directions

Pattern recognition is a fast-moving and proliferating discipline in the current computing environment. Pattern recognition is one of the most important functionalities for intelligent behavior and is displayed by both biological and artificial systems. In addition, pattern recognition systems are successful to the extent that they can continuously adapt and learn from examples; the underlying framework for building such systems is predictive learning. The pattern recognition problem is a special case of the more general problem of statistical regression; it seeks an approximating function that minimizes the probability of misclassification.The future scope of this work may be extended in the directions of scaling factor of various pattern recognition algorithms and working with real world data.

References

1. A.K. Jain, Robert P.W. Duin, J. Mao: Statistical Pattern Recognition: A Review, IEEE Transactions On Pattern Analysis And Machine Intelligence, Vol. 22, No. 1, January 2000.
2. M. Kikuchi, K. Fukushima: Invariant pattern recognition with eye movement: A neural network model, Elsevier, Neuro computing 38-40 (2001) 1359-1365.

3. M. Joo, S. Wu, J. Lu, H.L. Toh: Face Recognition With Radial Basis Function (RBF) Neural Networks, IEEE Transactions On Neural Networks, Vol. 13, No. 3, May 2002.
4. Y.A. Alsultanny, M.M. Aqel: Pattern recognition using multilayer neural-genetic algorithm, Elsevier, Neurocomputing 51 (2003) 237 – 247.
5. H. Inoue, H. Narihisa: Efficiency of Self-Generating Neural Networks Applied to Pattern Recognition, Elsevier, Mathematical and Computer Modelling 38 (2003) 1225-1232.
6. M. Han, J. Xi: E cient clustering of Radial Basis Perceptron Neural Network For Pattern Recognition, Elsevier, Pattern Recognition 37 (2004) 2059 – 2067.
7. L. Liang, D. Wu: An application of Pattern Recognition On Scoring Chinese Corporations Financial Conditions Based On Back propagation Neural Network, Elsevier, Computers & Operations Research 32 (2005) 1115–1129.
8. E. Artyomov, O.Y. Pecht: Modified High-Order Neural Network For Invariant Pattern Recognition, Elsevier, Pattern Recognition Letters 26 (2005) 843–851.
9. X. Shi, L. Wang, N. Kariuki , J. Luob, C.J. Zhong, S. Lua: A multi-module Artificial Neural Network Approach To Pattern Recognition With Optimized Nanostructured Sensor Array, Elsevier, Sensors and Actuators B 117 (2006) 65–73.
10. G. Ou,Y.L. Murphey:Multi-class pattern classification using neural networks, Elsevier, Pattern Recognition 40 (2007) 4 – 18.
11. N.G. Pedrajas, D.O. Boyer:A Cooperative Constructive Method For Neural Networks For Pattern Recognition, Elsevier, Pattern Recognition 40 (2007) 80 – 98.
12. Y.X. Zhang: Artificial neural networks based on Principal Component Analysis Input Selection For Clinical Pattern Recognition Analysis, Elsevier, Talanta 73 (2007) 68–75.
13. K.S. Swarup: Artificial Neural Network Using Pattern Recognition For Security Assessment and Analysis, Elsevier, Neurocomputing 71 (2008) 983–998.
14. M. Majewski, J.M. Zurada: Sentence recognition using artificial neural networks, Elsevier, Knowledge-Based Systems 21 (2008) 629–635.
15. C.J. Lin, J.G. Wang, C.Y. Lee: Pattern Recognition Using Neural-Fuzzy Networks Based On Improved Particle Swam Optimization, Elsevier, Expert Systems with Applications 36 (2009) 5402–5410.
16. M. Balasubramanian, S. Palanivel, V. Ramalingam: Real Time Face And Mouth Recognition Using Radial Basis Function Neural Networks, Elsevier,Expert Systems with Applications 36 (2009) 6879–6888.
17. S. Ghorpade, J. Ghorpade ,S.Mantri:Pattern Recognition Using Neural Networks, International Journal of Computer Science & Information Technology (IJCSIT), Vol 2, No 6, December 2010.
18. J.D. Wu, C.T. Liu: Finger-vein pattern identification using SVM and neural network technique, Elsevier, Expert Systems with Applications 38 (2011) 14284–14289.
19. L. Akanbi, O. Odejobi: Automatic Recognition Of Oral Vowels In Tone Language: Experiments With Fuzzy Logic And Neural Network Models, Elsevier, Applied Soft Computing 11 (2011) 1467–1480.
20. G. Xianhai: Study Of Emotion Recognition Based On Electrocardiogram And RBF Neural Network, Elsevier, Procedia Engineering 15 (2011) 2408 – 2412.
21. C. Micheloni, A. Rani, S. Kumar, G.L. Foresti: A balanced neural tree for pattern classification, Elsevier, Neural Networks 27 (2012) 81–90.
22. S. Kumar, M. Singh: Study Of Hopfield Neural Network With Sub-Optimal And Random GA For Pattern Recalling Of English Characters, Elsevier, Applied Soft Computing 12 (2012) 2593–2600.

Biographical Notes

Mr. Mohinikanta Sahoo working as an Asst. professor in Dept. of CSE at DRIEMS, Tangi, Cuttack. He has completed his M.Tech in Computer Science and Engineering at VSSUT, Burla in the year 2015. He has published 2 papers in Springer International conference. His area of interest is soft computing and neural network. He has 5 years of teaching experience.