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A Review Paper on Machine Learning in Pattern Recognition

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ABSTRACT: Supervised or unsupervised classification is the main goal of pattern recognition. The statistical approach is the most popular approach that prevails among the many frameworks in which pattern recognition is initially formulated. Recently, more attention has been paid to neural network techniques and methods derived from statistical learning theory. This requires attention to the design of the sensor system. There are various issues related to the design of identification systems. They are the definition of pattern classes, the detection and extraction environment, representation and feature selection, cluster analysis, classifier design, learning and selection of training and test samples. There is no solution to the general problem of complex pattern recognition associated with arbitrary patterns. Data mining, web search, and multimedia retrieval have several emerging applications that require appropriate and effective tuning techniques. The main goal of this article is to provide a detailed description of different methods that can be used in different stages of a pattern recognition system. The purpose of this paper is also to explore research topics in application that can be highlighted in this challenging field.

KEYWORDS: Classification, Neural Network, Machine Learning, Pattern Recognition, Pattern Matching, Security.

I. INTRODUCTION

Many systems include data mining for preprocessing, analysis, and interpretation of data. There are two areas in which these tactics can be used and classified: pattern recognition and machine learning. The main goal of pattern recognition is to prove distinguishable things and testable relationships. To put it another way, pattern recognition is crucial for identifying patterns in the data that is provided. The technique of identifying patterns is connected to the appearance of images, although the original type of application is not considered.

Machine learning technology is concerned with extracting generalized knowledge from information that can be used for the prophetic task. To combat and overcome pattern recognition problems, some solutions have been proposed. Among the options put up to address the pattern recognition issue, machine learning techniques have been emphasized in this article. The plan makes use of rule-based learning, Naive Bayes classifier, decision trees, and support vector machines. The underlying idea of all suggested techniques is that explicit rule determination is not necessary. By classifying input data supervised and unsupervised, machine learning features can be achieved. This is in contrast to the directed classification approach, which uses pre-characterized classes for each piece of information and previously stored learning data to determine classes; in unsupervised classes, classes are connected using both input pattern and class similarity.

In order to address pattern recognition issues, new learning techniques such as transfer learning, multi-instance learning, and various recently developed deep learning technology trends have been employed. A few common pattern recognition problems include scene tracking, language classification, object detection, drug activity prediction, and image classification. Automated learning techniques combined with artificial neural networks have shown to be beneficial for solar radiation prediction. Artificial neural networks are frequently used in conjunction with machine learning techniques such as Support Vector Regression (SVR), Random Forest, K-means, Boosting approaches, and SVM. The performance of convolution neural networks for nodule detection in the medical area for analysis functions can be improved with the introduction of a new imaging technique known as large-scale training artificial neural networks. This process allows for the removal of certain manually manufactured characteristics. The proposed model is able to recognize and categorize focalization defects in the absence of high-level semantic characteristics.

Additionally, because their images are very consistent and specific when the user's age is taken into consideration, facial recognition, handwriting recognition, speech recognition, and fingerprint recognition are some of the most popular used pattern recognition solutions of various biometric technologies.

Pattern recognition, or the ability to identify patterns in data, is crucial to the design and development of systems. Identification of a real-world scene and its descriptive description in a way that will help with task completion are the primary goals of pattern recognition software. Real-world observations are largely gathered through advancements in sensors and patterns. Utilizing the observations, a feature extraction process computes the numerical symbol information. These approved attributes are categorized using a classifier after the digit symbol information has been computed. To guarantee effective pattern description, the pattern recognition method comprises of multiple steps. Consequently, it makes sense to use knowledge-based approaches to address pattern evolution in order to boost both the accuracy and recognition rate. In order to identify the most effective pattern recognition technique, a review paper has been written that examines machine learning in the context of pattern recognition using a number of contemporary approaches to improve performance accuracy and identify potential fixes for various problems pertaining to data mining and related fields.

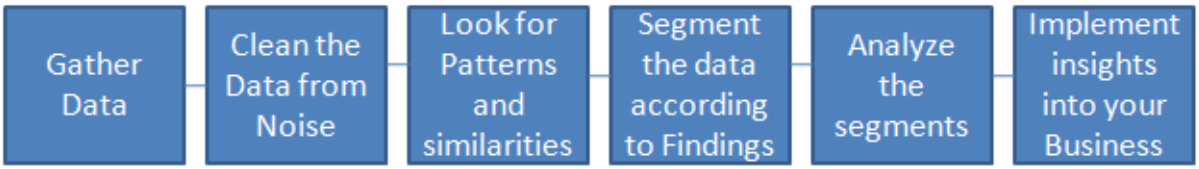


Fig 1. Machine Learning in Pattern Recognition

Pattern Recognition

Machine learning algorithms have a feature called pattern recognition that is frequently used to find patterns. Utilizing statistical information gleaned from patterns and representations, pattern recognition techniques categorize data. Using labeled training data, this method addresses pattern recognition systems. A level that is linked to a certain input value causes the output to follow a pattern. In the absence of labeled data, alternative computer methods are employed to detect undiscovered patterns.

A. Research Objective

This study aims to explore different ways that machine learning approaches are used in pattern identification. The literature review section of the article will cover the scholarly contributions of many scholars, along with a detailed explanation of the advantages of pattern recognition, implementation issues, and the significance of machine learning techniques for pattern matching and recognition.

B. Research Motivation

Pattern recognition is used in computer vision, content, speech recognition, text classification, record inspection, data processing, image processing, and neural network systems. Pattern recognition plays a crucial part in machine learning, and when paired with machine learning, it may be applied in a variety of fields, including big data analysis, bioinformatics, biometrics, and advanced data science. The process of classifying incoming data into classes and objects based on distinguishing characteristics is called pattern recognition. One will learn about numerous analyses done on machine learning-assisted pattern recognition approaches by reading the paper.

II. LITERATURE REVIEW

A. Evaluations of Applications for Pattern Recognition

Nair et al.[1] has developed a method for identifying face authentication systems that uses boost for face and eye identification along with a Haar-like characteristic. The outcome of this method is really encouraging since it shows that facial authentication on mobile devices is feasible. For small-sized items, the proposed result attained an average authentication rate of 82%, while for medium-sized devices, it reached up to 96%.

A low-cost biometric identification system for mobile phones featuring face detection, registration illumination, generalization verification, and information fusion was developed by Silasai and Khofa[2]. The technique helps attain an anal error rate of 2% in analysis.

B. Algorithm for Pattern Identification

The different algorithms that have been applied for pattern recognition are listed below.

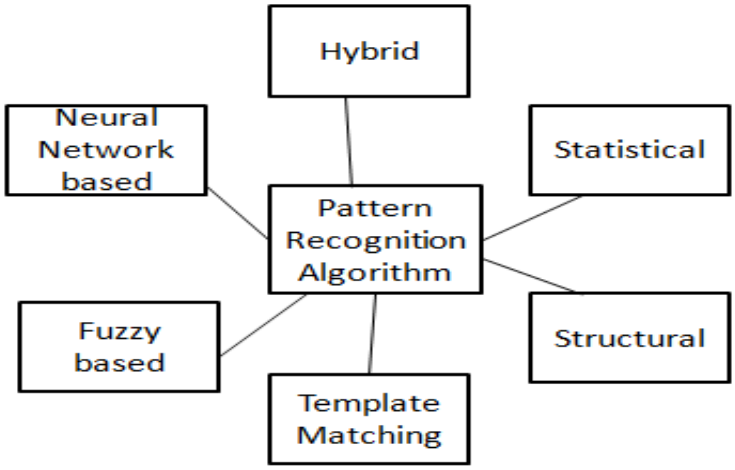


Fig 2. Pattern Recognition Algorithm

1. Structural Algorithm:- The structural algorithm is crucial for dealing with complicated pattern recognition processes, and it is essential when working with multidimensional entities. Subclasses of the pattern can be created, forming a hierarchical structure. The structural model defines the connections among the components of the system.
2. Hybrid Algorithm:- Using these kinds of algorithms, hybrid models are produced that allow users to examine several classifiers at once in order to spot trends. Hybrid algorithm classifiers receive feature-base-related training. To get rid of this, a collection of combiners and classifiers is employed. The classifier's accuracy is also evaluated using the decision function.
3. Statistical Algorithm:- In an organization, statistical models are created using statistical methods. Patterns in this model are characterized by their features. This model makes it possible to forecast that the pattern is probabilistic. Clusters are created using a variety of specified attributes. By examining the pattern's probability distribution, the system adjusts its optimization appropriately. After then, the pattern is observed for processing, and in order to find it, the model is exposed to various patterns.
4. Template Matching Algorithm:- In order to create a template-matching model using a basic recognition model, the template-matching algorithm is crucial. This model compares patterns in images and stores the patterns that match as templates for the pattern recognition model. Nonetheless, this model's primary drawback is its poor performance in identifying distorted patterns.
5. Fuzzy Based Algorithm:- Fuzzy logic is used in this process, and truth values between 0 and 1 are used. This model matches the given input with the result by applying specific criteria. Because our fuzzy-based approach can handle unknown domains, the results are extremely satisfactory.
6. Neural Network Based Algorithm:- In this model, neurons—parallel structures—are taken into account. Because of its enhanced learning capabilities, it is among the best models for pattern recognition. The neural network model most commonly applied to pattern recognition is feed-forward back propagation neural networks.

C. Tools used for pattern recognition in Machine Learning

1. Google cloud auto ML:- A key piece of technology is Google Cloud AutoML, which is employed to construct superior machine learning models. This method builds models by starting with an integrated learning and neural network.
2. Amazon lexes:- This tool, which is available as open-source software from Amazon, is essential for creating chat bots and other intelligent conversion agents that use text and voice recognition.

D. Pattern Recognition and Machine Learning Scope

1. Image Processing:- Image processing can be divided into two categories: analog and digital. The term "online photo handling" describes the application of clever machine-learning algorithms to improve the quality of images acquired from a distance, like a satellite.
2. Recommender System:- Among websites dedicated to purchasing items online, recommendation algorithms are common. Recommendation systems utilize machine learning algorithms to identify patterns in client purchasing behavior by analyzing data based on past purchases.
3. Bioinformatics:- Based on biological data, bioinformatics is a scientific field that uses software and computer tools to create predictions. The discovery of a new protein in the lab that has no known sequence is a good example of bioinformatics in action. A vast number of proteins kept in a database can be compared to an unknown protein with the aid of bioinformatics techniques. This will assist in modifying the sequence associated with two comparable patterns.

III. METHODS AND MATERIALS

Process of Pattern Recognition

In order to recognize patterns, the idea of learning is employed. In order for pattern recognition systems to be trained and adjusted to provide results, understanding concepts is essential to it.

The remaining portion of the element is utilized for testing, whereas the data set component is crucial to the system's training. Here are some pictures that demonstrate how data may be used for both testing and training.

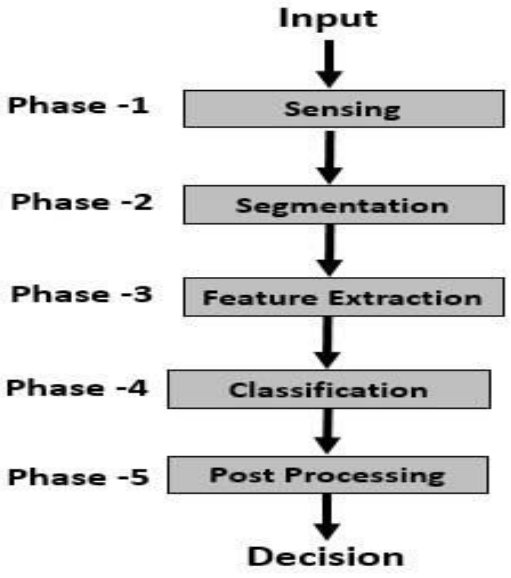
The training set includes data images that are essential for putting the model to use. To provide standards for the decision-making process, training rules are applied. Additionally, a training algorithm that matches the choice with the input data that is provided is crucial. The implementation of the algorithms and rules occurs during the training phase, which comes next. To get outcomes, the system uses information that it has collected from data.

The test set validates the accuracy of the system, and test data is crucial in determining the accuracy of the output.

Pattern recognition systems operate in five primary steps:

The following is a list of the different steps:

1. Sensing: At this phase in the pattern recognition system, the input data is converted into analog data.
2. Segmentation: The segmentation process guarantees the isolation of the sensed object.
3. Feature Extraction: The object is passed to the following classification after its attribute has been identified during the extraction stage.
4. Classification: The following step is the categorization stage, in which the sensed object is arranged in a group.
5. Post processing: A final selection is made after more deliberation in the post-processing phase.



IV. RESULTS AND DISCUSSION

It is undeniable that machine learning is becoming more and more popular, and we use it often even without realizing it. Machine learning approaches are frequently categorized as either supervised or unsupervised. In reference to the supervised approach, this algorithm anticipates that an individual will supply the data in addition to the intended yield. Calculations will be performed to ascertain the outcome of the new information after the preparations are finished. In contrast, unsupervised learning employs an iterative process called deep learning to audit the data and make judgments because there is no way for the algorithm to be ready with the necessary outcome knowledge. Supervised learning frameworks have no bearing on the completion of unsupervised tasks, which are carried out through the use of unsupervised learning techniques.

This study reviews and illustrates current advances in pattern recommendation theory by focusing on machine learning-related methods for solving diverse categorization challenges. Furthermore, reading newspapers will offer a thorough examination of pattern recognition, encompassing voice gesture, iris, and handwritten cursive word identification in addition to facial recognition.

The review comes to the conclusion that there are numerous applications for invariant pattern regularization, including facial and character recognition. However, highlighting the royal feature's command was a difficult undertaking, as evidenced by our early statistical pattern recognition research. Recently, efforts have been made to shape journal recognition without the need for motion pictures, such as Associate Neighbor classifiers, by using touch line distance and matching criteria.

V. CONCLUSION

The 21st century is seeing a rise in the popularity of machine learning, which can be attributed to its main benefits. Owing to its incredible potential, machine learning technology is poised to completely transform a variety of industries. Examples of these industries include pattern recognition, data mining, analytics, and more. Whether it is employed for technical or non-technical purposes, pattern recognition is a tool that is linked to machine learning.

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