

A Survey of Image Classification and Pattern Recognition using Deep Learning

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Abstract— One of the most important branches of Artificial Intelligence is Pattern Recognition, which focuses on the description, measurement and classification of patterns involved in different data. Great progress has been made in both the theory and implementations of pattern recognition in the past 60 years. Pre-processing, feature extraction, classifier design and post-processing are composed of a standard pattern recognition system. Nowadays, we have reached a new age of big data, which brings the field of pattern recognition both opportunities and challenges. To be sensitive to big data, we should seek new pattern recognition theories. We should put forward new applications for pattern recognition that benefit from big data.

Keywords— Pattern Recognition, Artificial Intelligence classification, big data.

Introduction

Deep learning, which can be regarded as the most important development in the field of pattern recognition and machine learning in the last few years, has significantly influenced the methodology of related fields such as computer vision and has made excellent progress in both academia and industry. Changing the entire pattern recognition system can be seen as a revolution. End-to - end pattern recognition was achieved, integrating previous preprocessing steps, extraction of features, classifier architecture and postprocessing. The advancement of deep learning theories and applications is expected to further impact the field of pattern recognition. [5].

Deep learning Techniques have been adequately connected to different zones like image classification, speech recognition, Medical Images detection, face detection, satellite images, recognizing traffic signs and pedestrian detection and so on. The result of deep learning techniques is likewise prominent and at times the outcomes are better than human experts.

From most recent couple of years the majority of the issues are additionally being re-explored different avenues regarding deep learning techniques with the view to accomplishing enhancements in the current

discoveries. Various architectures of deep learning have been presented as of late, for example, convolution neural systems, deep systems, and intermittent neural systems. The whole engineering has demonstrated the expertise in various zones. Character recognition is one of the regions where machine learning techniques have been widely tested. The principal deep learning strategy, which is one of the main machine learning techniques, was proposed for character recognition in 1998 on MNIST database [4].

The deep learning techniques are essentially made out of multiple hidden layers, and each hidden layer comprises of multiple neurons, which figure the reasonable weights for the deep system. A ton of registering force is expected to the deep learning techniques are essentially made out of multiple hidden layers, and each hidden layer comprises of multiple neurons, which figure the appropriate weights for the deep system. A great deal of processing force is expected to figure these weights, and a ground-breaking framework was needed, compute these weights, and an incredible framework was required which was not effectively accessible around then. From that point forward, the scientists have attracted their consideration regarding finding the method which needs less power by changing over the images into feature vectors.

Deep learning upsets the process of handcrafting and designing features for a specific issue into a programmed process to register the best features for that issue. A convolutional neural network has multiple convolutional layers to extract the features naturally. The features are extracted just once in the vast majority of the shallow learning models, yet on account of deep learning models, multiple convolutional layers have been embraced to extract segregating features multiple occasions. This is one reason that deep learning models are commonly fruitful. And additionally in Deep feed forward neural

networks the features are register naturally by utilizing diverse number of hidden layer in it [5].

Deep learning algorithms attempt to take in high-level features from data. This is a particular piece of Deep Learning and a noteworthy advance in front of conventional Machine Learning. Among all deep learning approaches, CNN is one of the most well known model and has been giving the best in class execution on object recognition. CNN approach has been intended to impersonate human visual preparing, and it has highly optimized structures to process 2D images. Further, CNN can adequately get familiar with the extraction and abstraction of 2D features [4].

A Convolutional Neural Network (CNN) is made of at one or more convolutional layers and then is taken after by at least one or more completely associated layers as in a standard multilayer neural system. The engineering of a CNN is intended to exploit the 2D structure of an information image. This is accomplished with nearby associations and linked weights that are carried further by some sort of pooling that brings invariant highlights of perception. Another benefit of CNNs is that they are easier to train and have far fewer parameters with a comparable number of line units than fully related systems. [5].

Convolutional Neural Networks (ConvNets or CNN's) [12, 13] are a class of Neural Networks that have demonstrated extremely compelling in application zones, for example, picture acknowledgment and characterization. In identifying faces, objects and motion signs apart from regulating vision in robots and self-driving vehicles, ConvNets have been fruitful.

Pattern recognition is the research area that studies the operation and design of systems that recognize patterns in data. Application areas such as image analysis, character recognition, Speech recognition, man and machine diagnostics, person identification and industrial inspection are of tremendous practical significance and encompassed by pattern recognition. It has been well understood that these problem can be performed well and effortlessly by human brain. However, their solution using computer has, in many cases proved to be immensely difficult. In order to have the best opportunity of developing effective solutions, it is important to consider the various existing approaches and methods for pattern recognition with the machine.

The number of features of the pattern samples is usually very large. The features of the pattern samples are reduced by considering their salient characteristics. This process is referred to as feature extraction. Several approaches for feature extraction have been proposed by the various researchers such as feature extraction by moment's invariants [4].

The last issue of the statistical pattern recognition is the pattern classification or development of the classifier. The pattern classifier is defined as a device or a process that sorts the given data into identifiable categories and classes. The pattern classification is an information transformation process, i.e., the classifiers transforms relatively large set of mysterious data into a smaller set of useful data [3]. Trainable classifier is one that can improve its performance in response to the information it receives as a function of time. Training is a process by which the parameters of the classifiers are adjusted. The classifier is trained using the reduced pattern samples. It is often assumed that the pattern samples of a given class occupy a finite region in a pattern space and it is called a class region.

Other researchers have joined the trend after the first attempts to combine GA and NN began in the late 1980s and produced a flood of journal papers, technical studies, Different GANN methods, such as face recognition, animals[1,15], thyroid gland normality classification, color recipe prediction and many more, have investigated a wide range of problems. A variety of diverse encoding techniques have also been introduced. [14].

Literature review

In this paper they proposed a method to classify partial discharge types of the unstructured time-domain waveform image. With the application of big data technology, a large amount of unstructured data on site like the partial discharge image is accumulated. The proposed algorithm can directly process the unstructured data and simplify the feature extraction steps in pattern recognition. It is with higher accuracy compared to SVM and BPNN model. Also, it reduces the experimental complexity and has good robustness. This method is also applicable to other unstructured data accumulated by the big data platform. It is of great significance for further work of data mining and improve the efficiency of data utilization[1].

Electromyogram EMG signals of left forearm under arm extension, inward rotating and outward rotating of wrist, fisting and opening hand were recognized using BP neural network, LVQ neural network and BP-LVQ-combined neural network. Pattern recognition rates of the three kinds of neural networks were compared and result showed that BP-LVQ-combined neural network performed better than the other two networks, and also had higher recognition rates of outward rotating of wrist and fisting, which made solid foundation of adopting EMG signals into prosthesis control [2].

In this paper they used a shallow neural network model for graphical symbol recognition in multi-writer scenario. The main advantage of this network is the lesser number of parameters, which is quite simple to learn. We also show unlike many convolutional neural network (CNN) we can train a shallow CNN with unbalanced small dataset. Additionally the results also demonstrate the capacity of the network to capture the structure of the shape and deal with large deformations. The proposed deep learning model outperforms many state-of-the-art methods that usually work with hand crafted descriptors. In the future, it would be interesting to use the proposed network model hand drawn architectural symbol classification task [3].

In this paper they proposed convolutional neural networks or CNNs for Dot Patterns Recognition. CNNs is flexible to be tough to any kinds of patterns. MobileNet network is selected as CNNs model because of network size and accuracy. Raspberry Pi Zero W is selected as the hardware of the system and run on Linux kernel along with TensorFlow and coded in Python. In this research, the 60,000 hidden dot patterns images are used to train the network to achieve the good recognition performance. Because of limitation of memory and resources in Raspberry Pi hardware, the MobileNet is first trained and optimized in a notebook and then transfer trained network back to Raspberry Pi hardware [4].

Artificial Neural Network (ANN) is one of the main approaches for the characters recognition of handwritten in the occurrence of noise data. Handwritten recognition play vital role in various industrial applications. In the Handwritten recognition generated noise as one of the main concern that degraded the performance of character recognition

system. So to recognize the handwritten characters in different noise levels, to overcome this drawback, the back propagation (Backpropagation based ANN) is designed for the handwritten character recognition [2, 5].

Base of Optical Character Recognition (OCR), handwritten text recognition is an open research area. In this paper they proposed a well-organized approach in the direction of the improvement of handwritten text recognition systems. Basically three layers like inputs, hidden and output layers in Artificial Neural Network (ANN) is used. The selection of most favorable feature vectors deeply the accuracy of any text recognition system [6].

Many researches tried to develop such system in past. Although, there is requirement of much more research in field of pattern recognition with different methods to improve efficiency and accuracy. Such a lot of recognition works have been made for offline and online handwritten characters for some basic languages used worldwide: like English, Chinese, Sanskrit, odia, fasri as well as Indian scripts such as Devanagari, Malayalam and Bangla but they all suffer with some sort of problem: like slow conversion speed rate, slow accuracy, high false detection rate and poor performance with noisy input etc. In this manner, recognition investigations of handwritten character image tests still stay important in light of their extremely large application possibilities [16].

Pattern recognition or pattern classification or patterns grouping are key problem areas in a range of scientific and engineering disciplines such as 'signal processing', 'computer vision', 'artificial intelligence', 'image processing' and 'remote sensing'. A pattern may be an image of a fingerprint, a word or sentence written on a paper, a face or an isolated numeral. A pattern could be recognized in two ways. First, supervised classification, where the input class is identified as an element of a predefined class and second, unsupervised classification (e.g. clustering) where the pattern is assigned to an unknown class based on similarity in properties.

Pattern recognition is closely related to machine learning. This specific area of machine simulation emphasises on the searching of similarities between the stored pattern and supplied pattern [3].

They introduced new off-line method for handwritten alphabets character recognition system using multilayer feed forward neural network through diagonal based feature extraction is introduced for extracting the features of the handwritten alphabets [7].

Character segmentation is an operation, decompose an image is decompose in to a sequence of characters into sub-images of individual symbols. Optical character recognition (OCR) is used for decision, that a pattern isolated from the image is that of a character, it can be right or wrong. It is wrong sufficiently often to make a major contribution to the error rate of the system [15].



Figure 1.1 Block diagram of character recognition

Each and every person has different writing skill. Cursive Handwriting is also form hand writing. In this paper they highlighted cursive hand writing recognition due to the unique styles of writing from one person to another. A variety of researches have been conducted research in this field since approximately four decades. In this paper, they introduced an offline cursive writing character recognition system using neural network. The features of every character were extracted and then passed to the neural network for training. Various Data sets, having texts written by different people are used to train by different parameter of the system [8, 14].

Basically two types method of handwriting recognition, first and foremost off-line and another is on-line recognition methods. The input data means written text is scanning on the paper in the type of an image.

In the on-line method the 2 dimensional coordinates of subsequent peak are represented as a function of time. At time of comparison between the offline methods give great levels of accuracy in recognising the characters. In any handwritten recognition system is pre-processing followed by segmentation of handwritten character and feature extraction. Pre-processing is first step for shape of the input image in to segmented form. For effective recognition select feature extraction method [14].

In this paper they work on handwritten Sanskrit

character in an off-line recognition system with Neural Network for recognizing handwritten. In their system they will find practical applications in recognizing the handwritten names, reading documents and conversion of any handwritten document into proper text form. The work can be extensive to recognize characters or numerals of a few additional languages also for recognition of word [9].

In this survey they reviewed different handwritten character recognition techniques. They also use in its related various area by using ANN. They give direction for new researchers in field of working in the Character Recognition area.

They concluded that according to as technology is implementing step by step the need of Artificial Intelligence is expanding a result of just parallel processing. that as per as technology is developing day by day the need of Artificial Intelligence is increasing because of only parallel processing.

In this present time Parallel Processing is desired because with it helps to we can save additional time and money in the field digitalization. If considered for the future work it can only say that we have to design and develop a lot of algorithms for other problem solving techniques also. It can eliminate the limitations of the Artificial Neural Network [10].

Within few years, deep learning has led to exceptionally excellent performance on a range of problems, such as visual and speech recognition. Among different types of neural networks where convolution neural networks have been broadly studied. Pattern Recognition are extremely wide research fields with an massive variety of applications. They are also extremely difficult [5].

Different type of neural network and techniques has been implemented to achieve high recognition. These methods techniques have different perspectives of the recognition system.

This paper compares the current state of the art in online Japanese character recognition with techniques in western handwriting recognition. Here they compared eastern and western handwriting recognition techniques which allows learning and understand common foundations of handwriting recognition which is preprocessing, classification, and learning [12]. A segmentation and recognition method for

handwritten characters, such as place names, is some of the challenges like target and finds correct character from word and reducing computational complexity on the time of recognition of possible words. Neural network is used to train word using segmentation. Firstly network learns the spacing with size of word, which one should look forward to between different pairs of characters when character is handwritten. The idea of variable duration, which is obtained amid the training phase of a word recognition engine we have created, is expanded to diminish the computational intricacy which has been a genuine worry in this kind of application [13].

Neural network has been trained using known dataset. The number of input nodes is chosen based on the number of features. After applying convolution neural network, the recognition system was tested using an image dataset and the results obtained are analyse[17,18].

Conclusion

Here we survey on image to perform pattern recognition and observe the complexity with accuracy in two dimensional CNN. Furthermore, this method independent generalise features without manual extraction, which achieves low experimental complexity and robustness simultaneously.

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