

SURVEY ON HANDWRITTEN CHARACTER RECOGNITION USING MACHINE LEARNING

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Abstract- *Handwritten character detection has been a challenge and fascinating task with regards to the area of machine learning. The domain of artificial neural networks has a stretched history of several decades, where the theoretical contributions have progressed with advances in terms of power and memory in present day computers. Many algorithms have developed in recent years, have been successfully practiced in many fields of computer vision, like face recognition, object detection and image classification. A range of algorithms have indicated great precision for the handwritten letters of which are some looked here. This paper targets to review existing models for the handwritten character recognition using machine learning algorithms and put-forth logistic regression as a discriminative model together with multilayer perceptron for recognizing English characters. By combining the classifier outputs with the neural network optimal results can be achieved. Multilayer perceptron is chosen as the recognition model which is a feedforward ANN, particularly thanks to its high performance on nonlinearly divisible issues. The application is tested on a set of training data having digits with the flexibility to find out alphabetical or completely different characters.*

Keywords- Character recognition, Artificial neural networks, Logistic regression, Multilayer Perceptron, Computer vision, Image classification.

I. INTRODUCTION

The advancement of pattern identification procedures and machine learning throughout the years has exploited both theoretical and hardware progresses. More particularly, classifiers based on ANN such as multilayer perceptron have exploited graphics processing unit (GPU) highlighting the benefit of parallel and distributed systems in applications that require large databases for training models. The large increase of both power and memory can change how methods are perceived over time. While a few strategies during the 80s could only be utilized with little databases because of memory and computational issues, the present age of PCs, with intense GUPs and a lot of memory, largely driven by the video games industry, welcomes us to retry old procedures. In addition, the exponential increase of classification problems,

with the large amount of available data (Big data), forces researchers to take into account both the time for training and testing, but also the tradeoff between the accuracy and time to achieve this accuracy.

Handwritten character identification is a subject of research in NLP, computer vision, artificial intelligence and pattern recognition. A computer performing handwriting recognition is alleged to be ready to acquire and distinguish characters in paper archives, pictures and different sources and transform them into machine-encrypted form. Its purpose is found in OCR and more advanced ICR systems. The majority of these frameworks these days execute ML components, for example, neural networks.

II. IDENTIFY, RESEARCH AND COLLECT IDEA

Machine learning which is inspired by psychology and biology is a domain of artificial intelligence that deals with learning from a set of data and can be applied to solve wide spectrum of problems.

An early prominent endeavor in the territory of character recognition look into is by Grimsdale in 1959. The start point of a lot of research work in the mid 60's depended on a methodology known as analysis-by synthesis recommended by Eden in 1968. The incredible significance of Eden's work was that he formally demonstrated that every single manually written character are shaped by a limited number of schematic highlights, a point that was certainly incorporated into past works. This thought was later utilized in all strategies in syntactic (basic) methodologies of character recognition.

Drawing and Recognizing Chinese Characters with RNN [1], this paper investigates two closely-coupled tasks: Automatically reading and writing. Specifically, the RNN is used as both generative and discriminative models for recognizing and drawing cursive handwritten Chinese characters. Compared with previous CNN based approaches which require some image-like representations, this method is fully end-to-end by directly dealing with the raw sequential data. Because of the clear usage of the spatial and transient data,

our discriminative RNN demonstrate accomplished new high exactness on the ICDAR-2013 challenge database. Other than acknowledgment, this paper additionally considers automatic drawing of real and cursive Chinese character. A conditional generative RNN model is jointly trained with the character embedding, which allow the model to correctly write more than thousands of different characters. For modeling the pendirection gaussian mixture model is used which guarantee the diversity of the model in generating different handwriting styles. It is shown that the generated characters are not only human-readable but also recognizable by the discriminatory RNN model with great accuracies. Other than drawing characters, an interesting future direction is also given to utilize the proposed method as building blocks for the synthesis of cursive handwritten Chinese texts.

Deep Random Vector Functional Link Network for Handwritten Character Recognition [2] in this paper, authors have evaluated the performance of multi-layer RVFL/EML architectures on four handwritten databases. The number of layers and the total no. of projections in each layer have a major influence on the accuracy. The results confirm the interest of this type of approach for both the accuracy and the processing time. This type of classifier can be useful in applications with large labeled instances where a classifier has to be deployed rapidly. Further work will include convolutional RVFL/EML models to evaluate the choice of the pooling and convolution techniques.

Multi-Column Deep Neural Networks for Offline Handwritten Chinese Character Classification [3], this paper deals with extraordinary recognition rates on Chinese characters from the ICDAR 2011 and 2013 offline handwriting competitions, close to human precision. They are nearly one fifth better than the best previous artificial method. No handcrafted features are used and the networks learn features directly from the images. This execution is the aftereffect of averaging 11-layers deep networks with hundreds of maps for every layer, prepared on crude, misshaped pictures to keep them from overfitting. The whole system keeps running on a typical PC with a CUDA proficient graphics card.

NCFM: Accurate Handwritten Digits Recognition using Convolutional Neural Networks [4], in this paper, they have introduced a novel NCFM (No combination of feature maps) technique to abstract a variety of features. Each input feature map can get a output feature map without combining, which can avoid information loss and get higher accuracy. Specifically they proposed that CNNs with NCFM technique improve accuracy and speed up convergence and high performance with 99.81% accuracy rate is reached on the MNIST dataset. They compare the CFM(Combination of

feature maps) technique with NCFM technique and analyze the advantages. Firstly, NCFM converges faster than CFM. Secondly, NCFM performs better than CFM with fewer convolutional filters.

Feature Set Evaluation for Offline HRS: Application to the RNN Model [5], in this paper they propose a framework for feature set evaluation centred on a collaborative setting. RNN utilized here is a weighted vote mix of classifiers, each prepared with a distinct feature set. The primary goal of this paper is that significance of feature sets is quantified via the combination weights. They chose the RNN classifier because of its high performance. Also, they provide the first feature set benchmark for this classifier. Then Feature sets are evaluated on IFN/ENIT and RIMES DB of Latin and Arabic writing, respectively. The resulting combination model is aggressive which is best in class having accuracy of 93.9% and 82.1%, respectively for IFN/ENIT and RIMES DB.

Comparison Table of different papers

Method	Accuracy	Purpose
RNN is used as both discriminative and generative model [1]	98.36% over 375,500 test samples	Automatically reading and writing model for recognizing and drawing cursive handwritten Chinese characters. Compared with past CNN based methodologies this strategy is completely end-to-end by directly dealing with the raw sequential data.
Multi-layer RVFL/EML architectures [2]	CVL 96.02% Bangla 97.98% Devnagari 98.64% Oriya 96.40	This approach for improves both the accuracy and the processing time. This type of classifier can be useful in applications with large labeled instances where a classifier has to be deployed rapidly.

Multi-Column Deep NN [3]	95.875% (4.215% error rate) test set having 3755 classes of handwritten Chinese characters	MCDNN fundamentally improve over single DNN. The finest MCDNN has 4.215% error, much inferior than the finest DNN error, 5.528%. This is an absolute reduction of 1.313% and a relative reduction of 23.75%.
CNN with NCFM [4]	99.81% on the MNIST dataset.	CNNs with NCFM technique improve accuracy and speed up convergence and high performance with 99.81% accuracy rate is reached on the MNIST dataset. NCFM converges faster than CFM. NCFM performs better than CFM with fewer convolutional filters.
RNN utilized here is a weighted vote mix of classifiers [5]	93.9% and 82.1%, respectively for IFN/ENIT and RIMES DB	Significance of feature sets is quantified via the combination weights. Feature sets are evaluated on IFN/ENIT and RIMES DB of Latin and Arabic writing.
Logistic Regression using Neural Networks(Used model)	95.6%for Logistic Regression and 82.3%for Neural Networks.	Other models like CNN and RNN demand high computational power having high end graphic card whereas LR using NN can be implemented on a PC having enough

		memory and efficient CPU.
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IV. CONCLUSION

There are different methods through which handwritten character recognition is achieved. We studied existing papers for the handwritten character recognition using machine learning algorithms. We put-forth the benefits of using the logistic regression as a discriminative model together with multilayer perceptron for recognizing English characters. By combining the classifier outputs with the neural network optimal results can be achieved. The method to give efficient and effective result both for feature extraction as well as recognition. Paper also focuses on implementation part which uses logistic regression algorithm on a neural network. The logistic regression algorithm has been chosen because its better efficiency and accuracy from another algorithm. New features can be added to improve the accuracy of recognition. This algorithm can be attempted on large substantial database of handwritten written content. The work can be extended to work on degraded text or broken characters. This work further protracted to the character recognition for other languages.

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