ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijircce.com

Vol. 7, Issue 2, February 2019

Handwritten Text Recognition Using 2D-PCA and CNN

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ABSTARCT: Handwriting recognition (HWR) is the ability of a computer to receive and interpret intelligible handwritten input from sources such as paperdocuments, photographs, touchscreens and other devices. The image of the written text may be sensed "off line" from a piece of paper by optical scanning called optical character recognition(OCR).In this proposed paper there is a workflow and convolutional neural network model for recognizing offline handwritten characters from a text document. The learning model is based on Convolutional Neural Network (CNN) for classifying characters and Two dimensional principal component analysis (2D-PCA) for powerful feature extraction. The proposed method is better than modifying the CNN with complex architecture. This paper introduces a variant of the National institute of standards and technology(NIST) dataset, which we have called Extended Modified NIST (EMNIST), that follows the same conversion paradigm used to create the Modified (MNIST)dataset. The input for training is a dataset that constitute a more challenging classification tasks involving letters and digits and shares the same image structure and parameters as the original MNIST. By applying the segmentation technique the system can easily recognize each segments of lines and characters to produce a predictable results. The proposed paper can produce a good recognizable characters with improved accuracy in a short span of time.

KEYWORDS: Convolutional neural networks,Two dimensional principal component analysis,,Extended modified national institute of standards and technology.

I. INTRODUCTION

HWR is the ability of a computer to receive and interpret intelligible handwritten input from sources such as paperdocuments, pictures, etc.

This system principally includes optical character recognition. However a complete HWRsystem also handles formatting, performs segmentation into characters and finds the most clarity words. Off-line HWR involves the automatic conversion of text in an image into letter codes which are usable within computer and text-processing applications. The data obtained by this format is regarded as a static representation of handwriting.

One of the common characteristics of all the existing handwritten character recognition algorithms is that the character segmentation process is closely coupled with the recognition process. This process consists of three major portions, hand printed word segmentation, handwritten numeralSegmentation and cursive word segmentation. To perform PCA on the images a covariance matrix must be generated. To do so a matrix M was created in which each column represents an image, and each row a pixel of said image. Here the columns are the linear representation of the 2D pixel data - I organized the images linearly as one reads image pixel values from left to right and top to bottom. The values were then mean centered by subtracting the corresponding pixel value of the mean image. It was also successfully applied to other problems such as facial expression recognition, object recognition,etc. A neural network usually involves a large number of processors operating in parallel and arranged in tiers.By applying into tier the system can be easily classified for fine performance. The first tier receives the raw input information along with their weights and it is analogous to optic nerves in human visual processing. Each successive tier receives the output from the tier preceding it, rather than from the raw input in the same way neurons workflow in the nervous system. The last tier produces the

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output of the system.Neural networks are notable for being adaptive, which means they modify themselves as they learn from initial training and subsequent runs provide more information about the entire workflow.

In deep learninga CNN is a class of deep neural networks, most commonly applied to analyze visual imagery. CNNs use relatively little pre-processing compared to other image classification algorithms. This means that the network learns the filters in a good meaningful manner.The paper briefs eight related works of authors who have done this recognition process by using different techniques.After this discussion about related works there comes the proposed work ,architecture diagram and description. The modules of the proposed work and their description briefs about the recognition process in stage by stage. The results of this proposed work is represented using the snapshots.The techniques adopted and the key activities are described shortly in conclusion part and the further stages of developing this recognition process is discussed in the future works.

II. RELATED WORKS

Researchers were made to develop a varietyof methods and algorithms that can be used to recognize ahandwritten character.Off-line HWR continues to be an active research area.Towards exploring the newer techniques, there are various applications such asPostal sorting, bank cheque amount reading, and official document reading.Feature selection also used few search algorithms such as SequentialForward Selection (SFS), Sequential Backward Selection (SBS), Exhaustive search andGenetic Algorithm (GA). But Exhaustive search is not suitable for large database as it is a time consuming process.

Xin Wanget.al.,(2009)proposed a Handwritten character recognition based on BP neural network. They used genetic algorithm and back propagation as a key technique for this approach and achieved better accuracy 95%. J.Pradeep et.al.,(2011) proposed a handwritten text recognition neural network without feature extraction and focused mainly on the feed forward neural network. This work resulted in 90.19% accuracy. Gaurav kumar et.al.,(2013)proposed a Neural network based approach for recognition of text images.Real time control systems (RCS) algorithm and back propagation algorithm were applied for recognition process and used java neural networks for further implementation activities .They acquired a good accuracy rate with 93.58% and time execution is 8.85ms.

Siddhi sharma et.al.,(2014)proposed an Optical character recognition using artificial neural network approach. In this the authors proposed a multilayer feed forward neural network and wavelet decomposition technique for recognition system .It acquired a quite good accuracy rate of 84.8%.AnishaPriya et.al.,(2016) proposed a offline and online character recognition and applied various methodologies for online recognition. They obtained a nameable accuracy rate and a error rate of 7.2%.Gauri Katiyar et.al.,(2016)proposed a hybrid recognition system for off-line handwritten characters. They applied multilayer perceptron with genetic algorithm and Gradient Descent Back-propagation Algorithm. The accuracy rate is 91% and time taken is 43ms.Gauri Katiyar et.al.,(2017) proposed a recognition system using vector support machine as a classifier with an accuracy rate of 95.74%.

Savita Ahlawat et.al.,(2017) proposed an Offline Handwritten Numeral Recognition using Hybrid feature comparative Analysis. They employed genetic algorithm for feature extraction process and confusion matrix for classification process and acquired greater accuracy rate of 97.5%.

III. PROPOSED MODEL

In this proposed work initially a handwritten image of any format is taken as input and this image is converted into a standardized recognizable format (.jpg). This converted image undergoes preprocessing techniques. These techniques performs unique functionalities such as smoothing of an image, noise removal. These techniques are adopted to improve the accuracy of the image. Segmentation is a process after the preprocessing technique which includes bounding boxes of size (28x28) to bound each part of the image. To extract the principle component of English characters having the features by 2D-PCA method which makes within–class matrix with no longer singularity. The feature extraction uses the EMNIST and MNIST dataset. Then the best features are given to train the classifier using CNN. This CNN undergoes several layers to classify the image and stored as a model in a hierarchical data format (H5). By this activity the accuracy of the dataset can be predicted.

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3.1 Preprocessing:
The main goal of the pre-processing is to arrange the information to make the characterrecognition process simpler. The following pre-processing steps have been applied.

3.1.1 Binarization:
In order to avoid the problems resulting due to noise and lost information, the grayscale image of up to 256 gray levels is converted into binary matrix. Globalthresholding method have been used for binarization. If the intensity of the pixel is more than a particularthreshold value, it is set to white (represented by 1) and otherwise to black (representedby 0). In this work meanvalue is chosenas a threshold. Thethreshold value changes as the images change.

3.1.2 Dilation
The dilation is a processof solving whichsolves the problem that occurs in character recognition. This is mainly applied for the separation of text from a textured or decorated background. This is the most featured morphological process in the image recognition systems.

3.1.3 Smoothing and Noise Removal
Exact surrounding region of a character image can be determined by smoothing using Wiener filter. Median filter is applied to enhance the image quality by removingany leftover noise.

3.1.4 Segmentation:
The method for segmenting unconstrained printed andcursive words is proposed.The algorithm initially over segments on handwritten word images (for training andtesting) using heuristics and feature detection.
Using this process a set of words in an image is segmented into unique character for proceeding to further steps of processing. Segmentation points located in“test” word images are subsequently.

IV. ARCHITECTURE DIAGRAM

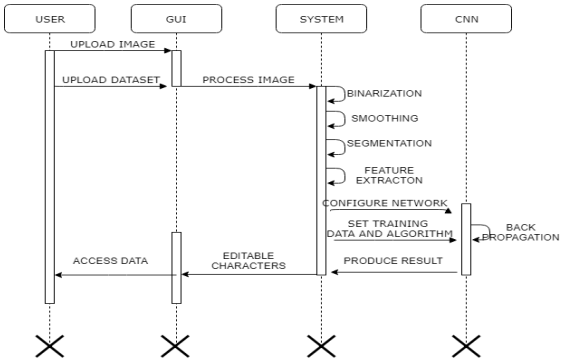

Fig 1: SYSTEM ARCHITECTURE

4.1 DIAGRAM DESCRIPTION:

The Figure1 represents the sequence diagram of four classes such as user, graphical user interface(GUI),system, CNN. which describes the workflow of the recognition process. Initially the user uploads the handwritten image of any format into the recognition system. The input image can be of any English characters either in uppercase or lowercase and numerals from 0-9. The dataset to process the image is also uploaded.Then the uploaded

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image is transmitted to the coversion process where the image is made to be (.jpg) format. The converted (.jpg) image undergoes certain preprocessing techniques such as binarization, smoothing, segmentation, feature extraction to improve accuracy. Then the CNN is used in this proposed work to configure network. Training dataset is used to predict the uploaded image for testing

5. TECHNIQUES OF ALGORITHM:

2D-PCA component analysis is a variant of the classical PCA, is developed for face recognition and also used for character recognition process.Different from the classical PCA,2D-PCA takes a 2D matrix based representation model rather than simply the 1D vector . In the PCA-based face-recognition technique, the 2D face-image matrices must be previously transformed into 1D image vectors. The resulting image vectors usually lead to a high dimensional image vector space in which it's difficult to evaluate the covariance matrix accurately due to its large size and relatively few training samples. Fortunately, we can calculate the eigenvectors (eigenfaces) efficiently using single value decomposition (SVD) techniques, which avoid the process of generating the covariance matrix. As a result, 2DPCA has two important advantages over PCA. First, it's easier to evaluate the covariance matrix accurately. Second, less time is required to determine the corresponding eigenvectors.

Usually, offline handwriting recognition approaches involve quite a few preprocessing steps to ensure robust recognition performance. On the other hand, for similar recognition problems based on convolutional neural networks, it is not necessary to design an efficient set of preprocessing steps to get rid of a portion of the variabilities present in the samples. The design of the architecture of CNN possesses an inherent mechanism to effectively take care of several sources of variation among the samples. In the proposed approach, the preprocessing step takes care of only normalization of the input image to the size Usually, offline handwriting recognition approaches involve quite a few preprocessing steps to ensure robust recogni- tion performance. On the other hand, for similar recognition problems based on convolutional neural networks, it is not necessary to design an efficient set of preprocessing steps to get rid of a portion of the variabilities present in the samples. The design of the architecture of CNN possesses an inherent mechanism to effectively take care of several sources of variation among the samples. In the proposed approach, the preprocessing step takes care of only normalization of the input image to the size Usually, offline handwriting recognition approaches involve quite a few preprocessing steps to ensure robust recognition performance. On the other hand, for similar recognition problems based on convolutional neural networks, it is not necessary to design an efficient set of preprocessing steps to get rid of a portion of the variabilities present in the samples. The design of the architecture of CNN possesses an inherent mechanism to effectively take care of several sources of variation among the samples. In the proposed approach, the preprocessing step takes care of only normalization of the input image to the size Usually, offline handwriting recognition approaches involve quite a few preprocessing steps to ensure robust recogni- tion performance. On the other hand, for similar recognition problems based on convolutional neural networks, it is not necessary to design an efficient set of preprocessing steps to get rid of a portion of the variabilities present in the samples. The design of the architecture of CNN possesses an inherent mechanism to effectively take care of several sources of variation among the samples. In the proposed approach, the preprocessing step takes care of only normalization of the input image to the size

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CNN is a feature extraction process which is built in keras using tensorflow as backend. Then by using the standard CNN with multiple convolution and maxpool layers, a few dense layers and a final output layer with softmax activation is made for the workflow. RELU activation was used between the convolution and dense layers and model was optimized using Adam optimizer.

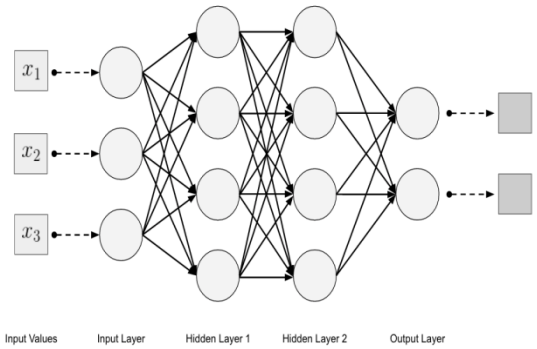

Fig 2: WORKFLOW OF CNN

VI. MODULE IMPLEMENTATION

The paper is implemented withsix modules which focuses on effective clarity of results with a better accuracy and improving execution time. The modules are

- Upload image
- Preprocessing
- Segmentation
- Feature Extraction
- Classification.

6.1 Upload Image:

An image of any format is uploaded as an input .The module works for uploading image and training dataset for training the neural networks . It converts any format of image to JPEG.

6.2 Preprocessing:

Pre-processing is performed to increase quality of handwritten/printed data and applied before the feature extraction. A sequence of operations has been performed on acquired image, so that subsequent tasks become easier.

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6.3 Segmentation:

The goal of segmentation is to simplify and change the image representation so that it can be meaningful and easier to analyze further. Segmentation involves line, word and character segmentation.

6.4Feature Extraction:

Feature Extraction is the process of extraction of certain types of information from the given character image.The features which are important for classification are extracted at this stage.

6.5Classification:

Classification is the decision making phase of Character Recognition system. This phase uses the features extracted in the previous stage for deciding the class membership and to recognize the input characters using neural networks.

VII. RESULTS&DISCUSSION

This HWR system results in more accuracy of characters at a high speed of execution. This result is executed using the enhanced CNN and 2D-PCA approaches.

VIII. RESULT SNAPSHOTS

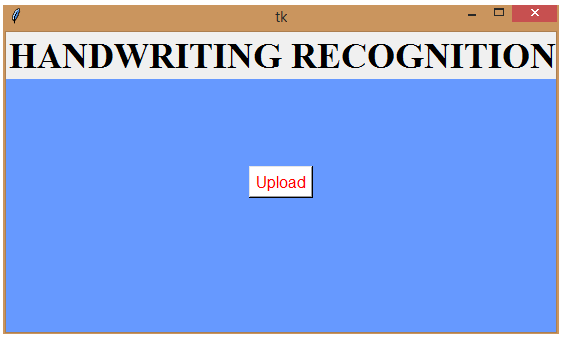

Fig 3: UPLOAD IMAGE

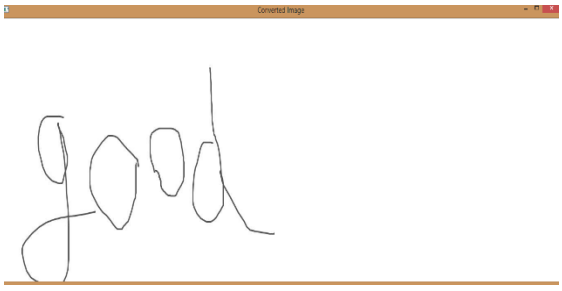

Fig 4:CONVERTED IMAGE

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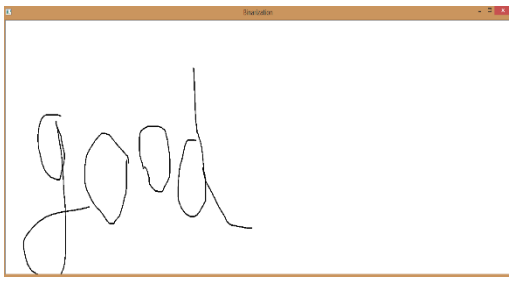

Fig 5: BINARIZATION

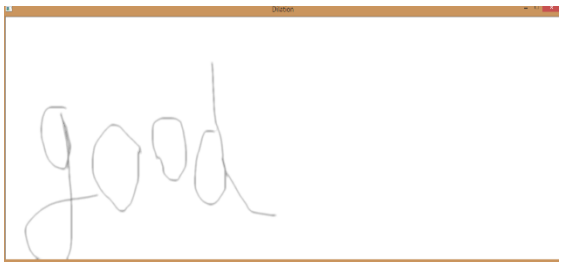

Fig 6: DILATION

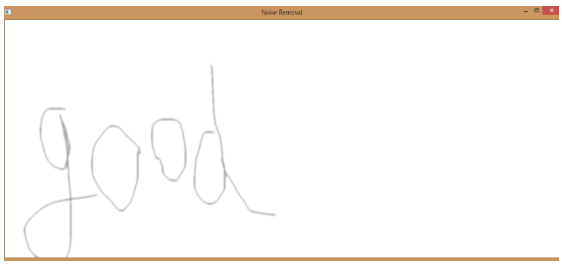

Fig 7: NOISE REMOVAL

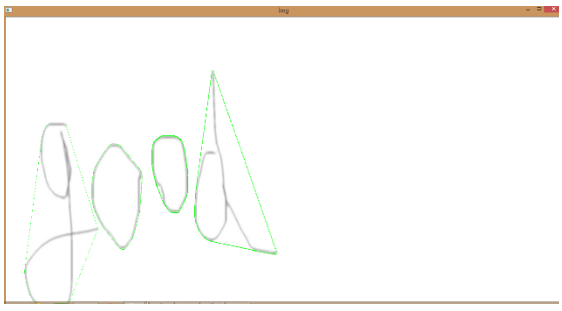

Fig 8: SEGMENTATION

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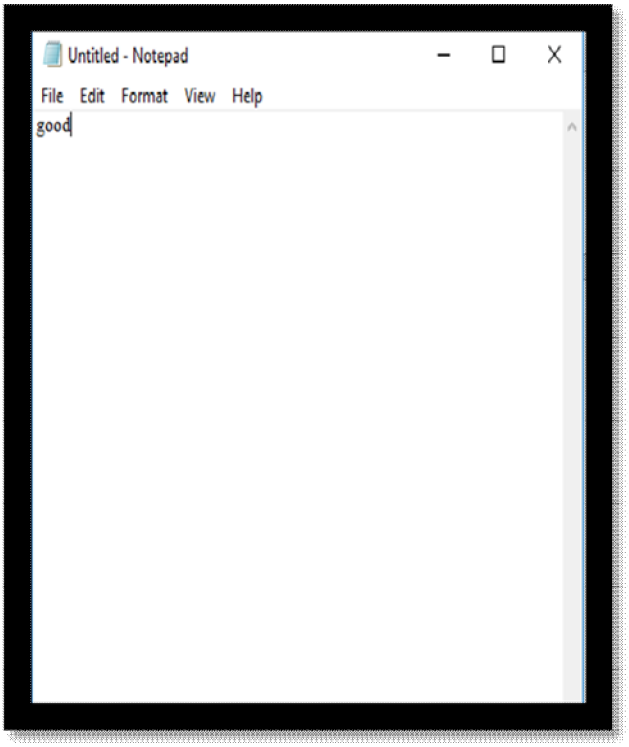

Fig 9: PREDICTED CHARACTER

IX. CONCLUSION& FUTURE WORKS

This handwritten text recognition is useful to predict characters from an image. This stands as one of the pillars of the digital platform to recognize characters without human effort.This is executed by adopting featured techniques such as BRISK which improves the accuracy by building the descriptors to the new level of recognition by analyzing related workflow.

REFERENCES

[1] Ali H, Ali Y, Hossain E, Sultana S (2010) Character recognition using wavelet compression. In: Proceedings of 13th internationalconference on computer and information technology (ICCIT), Bangladesh, December2010
[2] Arica N, Yarman-Vural FT (2001) An overview of character recognition focused on off-line handwriting. IEEE Trans SystMan Cybern .
[3] Avi-Itzhak HI, Diep TA, Garland H (1995) High accuracy optical character recognition using neural network with centroiddithering. IEEE Trans Pattern Anal Mach Intell.
[4] Chen MY, Kundu A, Zhou J (1994) Off-line handwritten word recognition using a hidden Markov model type stochasticnetwork.
[5] Cho SB (1999) Pattern recognition with neural network combined by genetic algorithm.
[6] Fuzzy Sets SysChouaib H, Cloppet F, Vincent N (2012) Fast feature selection for handwritten digit recognition. In: International conferenceon frontiers in handwriting recognition, ICFHR Italy.
[7] Chung K, Yoon J (1997) Performance comparison of several feature selection methods based on node pruning inhandwritten character recognition.
[8] M. M. Santoni, D. I. Sensuse, A. M. Arymurthy, and M. I. Fanany, “Cattle RaceClassification Using Gray Level Co-occurrence Matrix Convolutional Neural Networks.
[9] B. Kwolek, “Face Detection Using Convolutional Neural Networks and GaborFilters,” Artif. Neural Networks Biol. Inspirations - ICANN, 2005.
[10] C. V Dec, “Sparse arrays of signatures for online character recognition,” 2013.
[11] W. Yang, L. Jin, Z. Xie, and Z. Feng, “Improved Deep Convolutional NeuralNetwork For Online Handwritten Chinese Character Recognition using Domain-Specific Knowledge.”

ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijircce.com

Vol. 7, Issue 2, February 2019

[12] G. E. Hinton, N. Srivastava, A. Krizhevsky, I. Sutskever, and R. R. Salakhutdinov,"Improving neural networks by preventing co-adaptation of feature detectors arXiv.3 Jul 2012.
[13] Walid, R. and A. Lasfar. Handwritten digit recognition using sparsedeep architectures. in Intelligent Systems: Theories and Applications. (2016)
[14] Schmidhuber, J., Deep learning in neural networks: An overviewNeural Networks, 2015.
[15] LeCun, Y., Y. Bengio, and G. Hinton, Deep learning. Nature, 2015.
[16] Hinton, G.E. and R.R. Salakhutdinov, Reducing the dimensionality ofdata with neural networks. Science, 2006.
[17] Yu, K., et al., Deep learning: yesterday, today, and tomorrow. Journal ofcomputer Research and Development, 2013.
[18] Sun, Z.-J., et al., Overview of deep learning. Jisuanji Yingyong Yanjiu, 2012.