AN ANCIENT NUMBER RECOGNITION USING FREEMAN CHAIN CODE WITH DEEP LEARNING APPROACH

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ABSTRACT

Sanskrit character and number documents have a lot of errors. Correcting those errors using conventional spell-checking approaches breaks down due to the limited vocabulary. This is because of high inflexions of Sanskrit, where words are dynamically formed by Sandhi rules, Samasa rules, Taddhita affixes, etc. Therefore, correcting OCR documents require huge efforts. Here, we can present different machine learning approaches and various ways to improve features for ameliorating the error corrections in Sanskrit documents. Simulation of Sanskrit dictionary for synthesizing off-the-shelf dictionary can be done. Most of the proposed methods can also work for general Sanskrit word corrections and Hindi word corrections. Handwriting recognition in Indic scripts, like Devanagari, is very challenging due to the subtitles in the scripts, variations in rendering and the cursive nature of the handwriting. Lack of public handwriting datasets in Indic scripts has long stymied the development of offline handwritten word recognizers and made comparison across different methods a tedious task in the field. In this paper, a new handwritten word dataset will be released for Devanagari, IIIT-HW-Dev to alleviate some of these issues. This process is required for successful training of deep learning architecture, availability of huge amounts of training data is crucial, as any typical architecture contains millions of parameters. A new method for the classification of freeman chain code using four-connectivity and eight-connectivity events with deep learning approach is presented. Application of CNN LeNet-5 is found to be suitable to get results in this cases as the numbers are formed with curved lines In contrast with the existing FCC event data analysis techniques, sampled grey images of the existing events are not used, but image files of the three-phase PQ event data are analysed by taking the advantage of the success of the deep learning approach on image-file-classification. Therefore, the novelty of the proposed approach is that image files of the voltage waveforms of the three phases of the power grid are classified. It is shown that the test data can be classified with 100% accuracy. The proposed work is believed to serve the needs of the future smart grid applications, which are fast and taking automatic countermeasures against potential PQ events.

KEYWORDS

Deep learning, Freeman Chain Code, shape-based recognition, Power quality, Convolutional Neural Network, Lenet – 5, Handwritten digit recognition, character recognition, Artificial neural network.

1. INTRODUCTION

One of the principal aims of image processing is the recognition of the objects present in images. After the image features are extracted from the segmented objects, Pattern recognition tasks must be carried out for identification of the object. The human brain has a unique capability called categorization. Categorization is the ability to assign a meaningful label to an unknown object.

One of the principal aims of image processing is the recognition of the objects present in images. After the image features are extracted from the segmented objects, Pattern recognition tasks must be carried out for identification of the object. The human brain has a unique capability called categorization. Categorization is the ability to assign a meaningful label to an unknown object.

India owns a rich heritage of literature and language in the world. Hindi and Sanskrit are the prominent languages of India. Recognition in the regional language would be one of the greatest topics for research. For finding pattern of numbers from printed characters and extract the exact information from it, is a rarely focused task. Recognizing numbers in regional or ancient languages from written or printed scripters of ancient times, need to study major part of numbers formation. Identifying them is a process that includes traditional as well as neural network approaches. Most of the things written in ancient scriptures have become fuzzy and unclear. That makes recognition a challenging task.

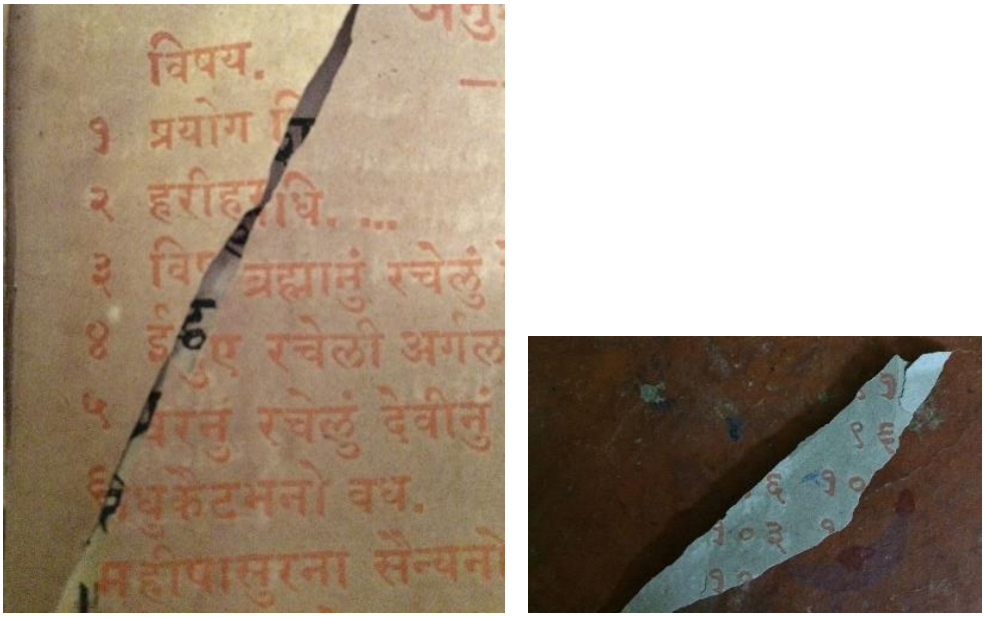

Fig. 1 Ancient Scripters

For better Accuracy and lower error rate, we proposed a new approach for Fuzzy and Noisy number recognition. For example, ancient times number which becomes so fuzzy and noisy till now.

Recognition of number in an image using a common image processing techniques is simple. In simple recognition, the error rate is higher. However, we have combined the FCC algorithm of image processing with neural networks of deep learning approaches for getting better results compared to common recognition technique. FCC is used for both Numeric as well as Image recognition [1]. The classification process is classified into different stages like Training and Testing.

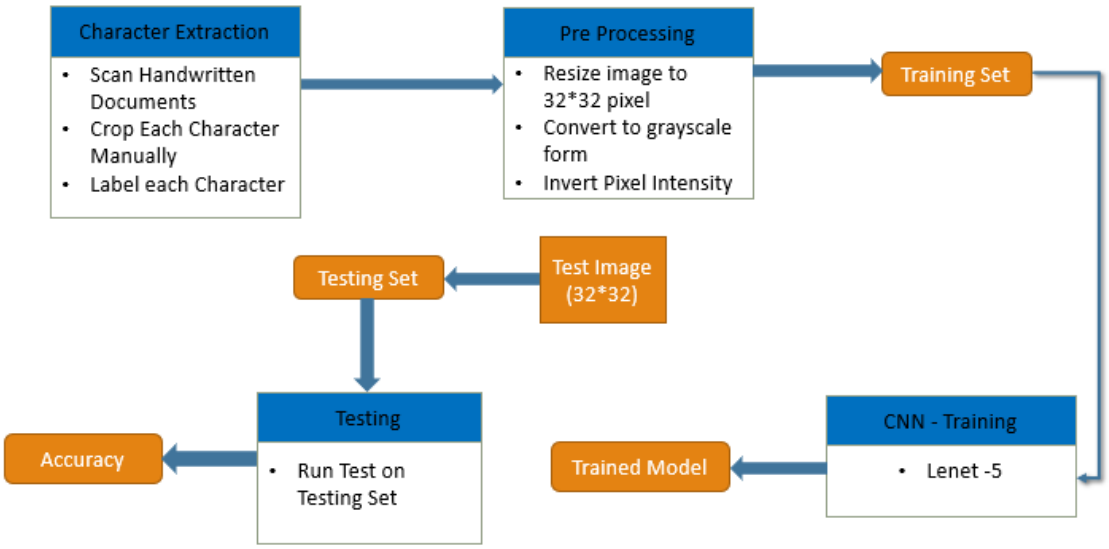

Fig. 2 Dataset Training - Testing Process.

The training phase consists of an algorithm that includes a known data set. This dataset is called training data. The training data should generally be large and representative. For example, if the application is about the diagnosis of cancer, then all types of cancer images should be given as input for the classifier to be effective.

The Lenet–5 model is already trained on a database which contains 60,000 images of handwritten digits. But for better accuracy, we again trained the neural network which contains 3000 Hindi and Sanskrit images of digits between 0 to 9.

Each digit contains 300 sample images from different ancient scripters. In testing phase, the constructed model is tested and evaluated with unknown test data.

2. SYSTEM OVERVIEW

Freeman codes are also known as chain codes. They represent the boundary of an image. Most of the boundaries are assigned numbers according to the directions. FCC is also useful for Pre-processing. Image Vector generates from FCC given as an input to PQ Event. Neural Network approach, LENET – 5 provides faster decision making with the best possible choice.

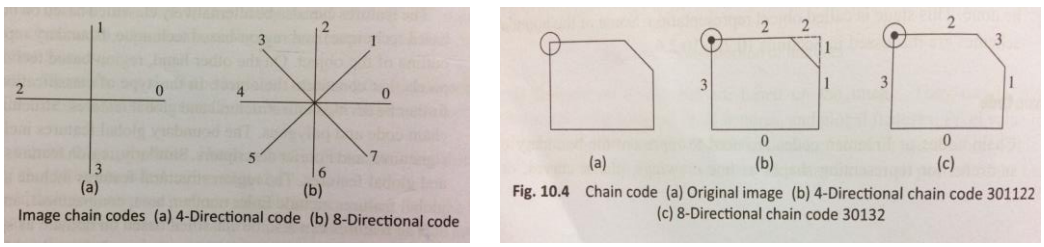

Fig. 3 Freeman chain code [34]

Power Quality is divided into various steps like feature extraction and classification. The first step includes capturing an input signal through the process. After that corrupted noise is removed before the event analysis process.

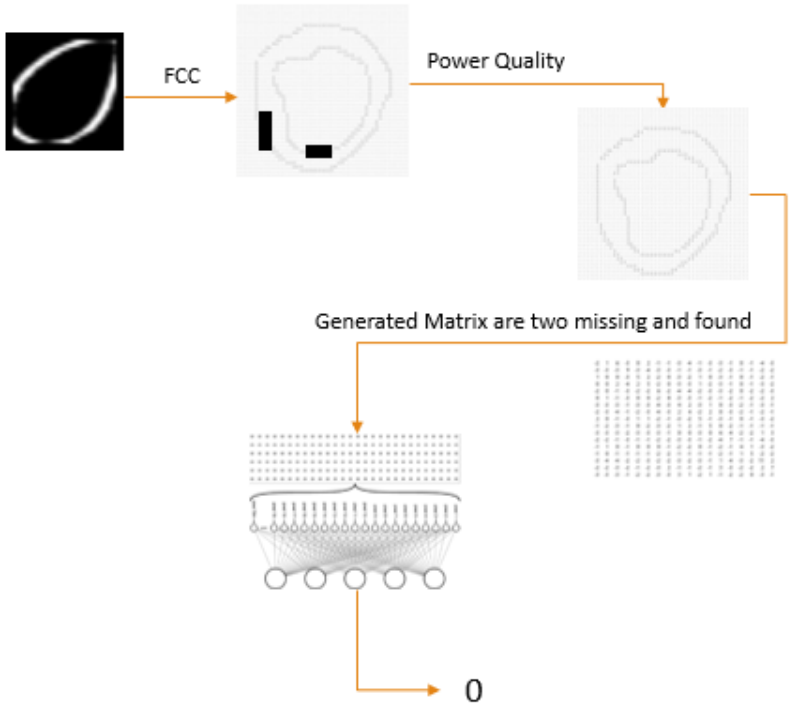

Fig. 4 Contour detection for Digit Recognition.[34]

The extracted features are used as input for Classification and fuzzy-based classifiers are used for the event classification. Additional processing - to process the input signal if corrupted to create a waveform. The equation for each input signal for feature extraction = f: R1^1 -> [0,256]^1 Selection with Fourier transform formula where f is calculated in the step above. Additional processing: will repeat the above formula (just by adding new input signals).

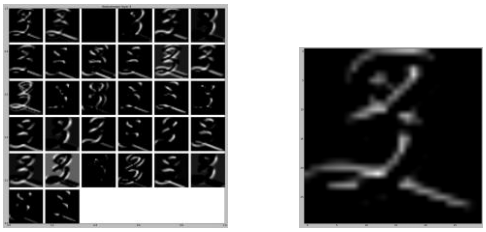

Fig. 5. Featured Maps – Digit 3

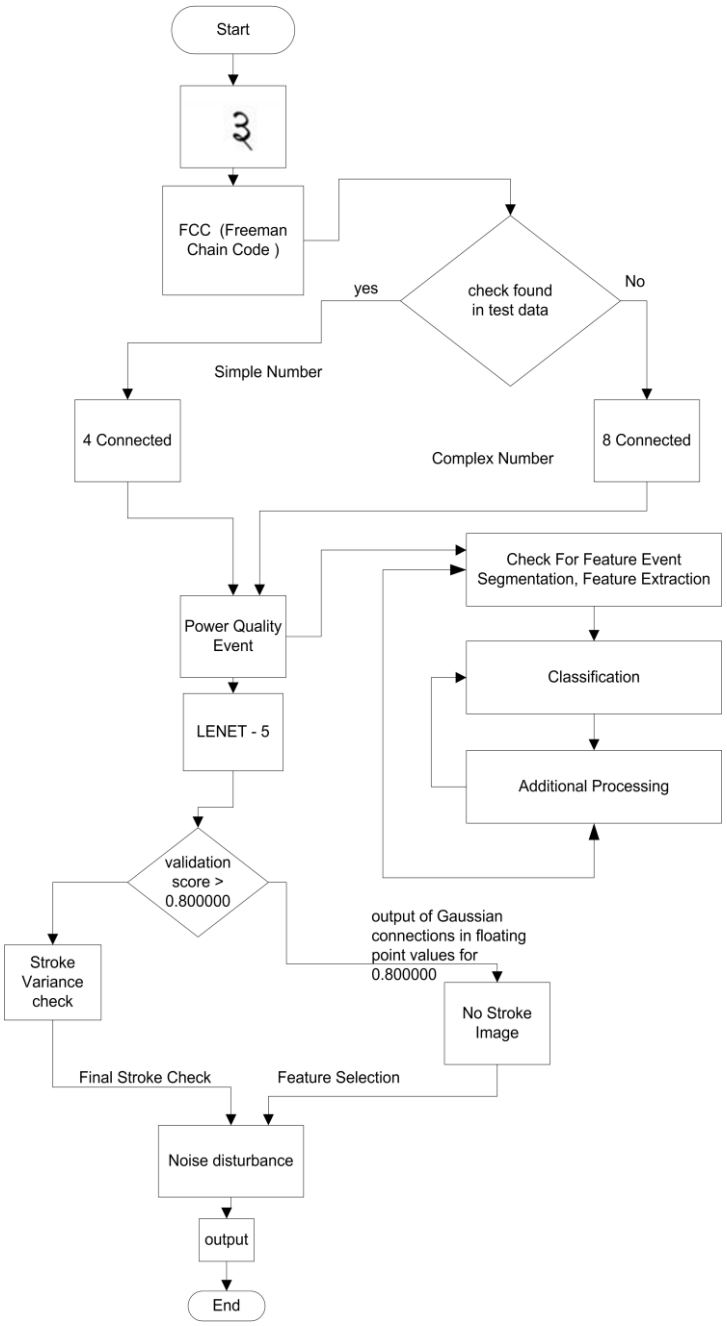

Fig. 6. Proposed System [7][20][22][23]

3. DATASET

Data that comes from the images of Hindi and Sanskrit numbers from ancient scripters. Deep learning and machine learning is highly based on the dataset for training and testing. All the images in dataset aBre 32*32 pixels. There are approximately 3000 images of Hindi and Sanskrit numeric used as a training dataset. The dataset contains images between 0 to 9 numbers and each number contains 300 images. For testing, Test Image size must be 32*32 pixel (Hindi and Sanskrit number image) and the depth bit is 8.

Usually, the data used for training is large and representative natured. Performance of the classifier is highly dependent on both factors.

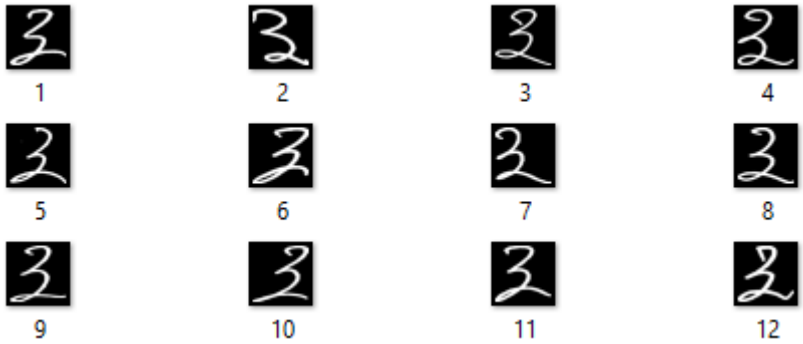

Fig. 7. Samples of number three from the dataset.

4. RECOGNITION RESULT

The classification can be evaluated by verifying the authenticity of true positive class examples and also the numbers that don't belong to the true negative class.

The correctness of classification can be evaluated by computing the number of correctly recognized class examples (true positives), the number of correctly recognized examples that do not belong to the class (true negatives), and illustrations that either were erroneously appointed to the class (false positives) or that were not perceived as class cases (false negatives). There are four methods useful for the prediction: TN, TP, FN, and FN. TN represents the negative case that was predicted negative, TP represents a positive case that was predicted positive, FN represents a positive case that was predicted negative, and FP represents a negative case that was predicted positive. Prediction performance of the proposed flow shown in Fig.5.

Precision is also known as the positive predictive value and all the numbers are correctly classified positive examples. Each example is divided by the total number of examples labelled by the system as positive. Precision is considered as the fraction of retrieved documents relevant to the query for the analysis of Information retrieval [14].

Table 1. The Performance measure of the proposed flow

Accuracy (A)	(TP+TN)/(TP+TN+FP+FN+F), (TP+TN)/(P + N)
Precision(P)	TP/(TP+FP), TN/(TN+FN)
Recall(R)	TP/(TP+FN)
F1-score	(2*P*R)/(P+R), F1 = 2TP / (2TP + FP + FN)
Accuracy (A)	(TP+TN)/(TP+TN+FP+FN+F), (TP+TN)/(P + N)
Precision(P)	TP/(TP+FP), TN/(TN+FN)

Table 2. The Performance measure of the proposed flow

	Number	TP	TN	FP	FN
1.	3	96	8	92	4
2.	5	92	2	98	8
3.	8	96	2	98	4
4.	4	99	7	93	1

	Number	Precision
1.	3	0.9231
2.	5	0.9787
3.	8	0.9796
4.	4	0.9340

A recall is also commonly described as sensitivity. It is the total number of positive examples that are classified correctly that are divided by the total number of positive examples in the test dataset. A recall is considered as the fraction of successfully retrieved documents in terms of information retrieval [14].

The numerical analysis represents that accuracy is the closeness of a Count to the true value and precision is the resolution of the representation. It is defined by the number of decimal or binary digits.

Table 3. Accuracy of performance of proposed flow

	Number	Accuracy
1.	3	94.00%
2.	5	95.11%
3.	8	97.24%
4.	4	96.00%

This is what CNN learns. As you can see, some filters have learned to recognize edges, curves, etc. CNN is very effective in learning the identification of the distinguishing features of one number from another.

Table 4. Recognition Result of Deep Learning Approaches

	Recognition Accuracy (%)	
	Deep Learning Approaches	
Digit	ANN	CNN
3	96.5	97.33
4	96.00	97.12
5	95.11	97.01

Table 4 shows the individual recognition accuracy of the same digit with different deep learning approaches. The best recognition result is obtained with CNN.

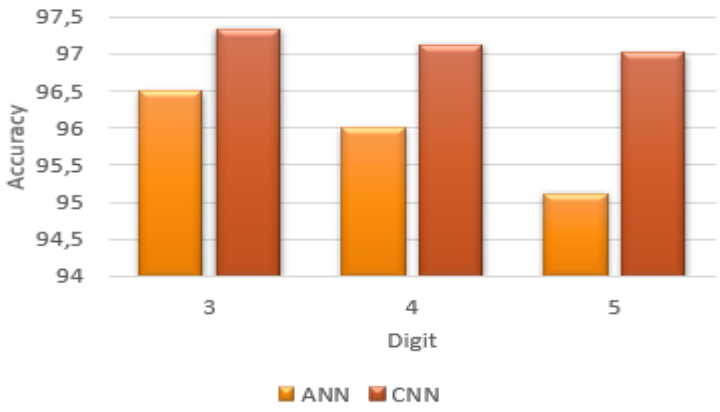

Fig. 8. Accuracy vs. Deep Learning Approaches

Above Graph shows the recognition accuracy for each digit with deep learning approaches ANN and CNN.

5. FUTURE WORK

This research offers a few roads for proceeded the Hindi and Sanskrit numbers with the investigation. In the research so far, the results got better than earlier. Rather, considering the most important outcome imaginable when all pixels are utilized. Particularly when working with Asian numbers, this can be the base of getting higher results for accuracy gained. The improvement analyzes between basic freeman chain code and freeman chain code with CNN (Lenet -5 model), with the help of neural network the pixel streamlining supports better utilization of fuzzy or unclear images. Furthermore, PQ events and Stroke variances are added to take it to specific results. Feature Extraction and Pre-processing are important steps of image recognition. Accuracy of recognition is directly proportional to the set of good features. For good feature extraction, Image should be well pre-processed. Good features describe the property of the image very well, which ultimately helps in learning well the recognition engine for a particular pattern.

6. CONCLUSION

This research offers a few roads for proceeded the Hindi and Sanskrit numbers with investigation. In the research so far, I have got better results than the earlier. Rather, I considered the most important outcome imaginable when all pixels are utilized. Particularly when working with Asian numbers, this can be the base of getting higher results for accuracy gained. The improvement analyzes between basic freeman chain code and freeman chain code with CNN (Lenet -5 model), with the help of neural network the pixel streamlining supports better utilization of fuzzy or unclear images. Furthermore, we have added PQ events and Stroke variances to take it to specific results. Feature Extraction and Pre - processing are the important steps of image recognition. Accuracy of recognition is directly proportional to the set of good features. For good feature extraction, Image should be well pre-processed. Good features describe the property of image very well, which ultimately helps in learning well the recognition engine for particular pattern.

Image recognition is the hottest research area over past decades, Different methods have been explored by a large number of researchers to recognize characters. Various approaches have been proposed and tested in different parts of world, including statistical methods, structural and syntactic methods and neural networks. No recognition is 100% accurate till now. The proposed

classification system could be implemented to design a complete ancient document digitizing system. Proposed system can be extended for the recognition of words, sentences and documents. And also, for multilingual character recognition. Ancient Number dataset contain Hindi and Sanskrit numbers. However, it is essential in the future to extend the dataset to include all the vowel characters.

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