

Handwritten Text Recognition Using Machine Learning

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Abstract

Character and have different shapes in this paper and it is really hard to recognize certain shapes. There are some confounding characters due to variations of shapes and there are very strong chances for misclassification or misrecognition. Neural networks are generally applied to recognition areas that are also handwritten. When using the Neural Networks the trained database is used and then tested on handwritten digits. In this work, the aim is to recognize the digits and special symbols the digits and special symbols by collecting the various text from the database of KAGGLE and MNIST. The database is collection of images of the handwritten text. The images are pre-processed, segmented and features are extracted. The subset of extracted features used for training the classifier. The performance of the classifier is tested for accuracy. Conventional 1 Neural Network and capsule Neural Network are used as classifier and their results are compared on digits and special symbol is recognition. Multiple learning techniques based on neural network for the handwritten recognition for characters , digits and special symbols ,and also new accuracy level for MNIST and KAGGLE dataset .The framework involves four primary levels are pre-processing , segmentation, feature extraction and CNN .This study improves the recognition accuracy more than 95% for the handwritten recognition for characters and digits. The database is collected and recognition the handwritten accuracy.

Keywords: Characters, Digits, Recognition, Machine Learning, Pre-Processing, Segmentation, Feature Extraction, Conventional Neural Network and Capsule Neural Network

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1. Introduction

This paper describes handwritten character, digit and special symbols. It is the conversion of images from scanned papers, handwritten documents and printed text into machine understandable format, which is possible by either handwritten documents, using scanned papers on an image. Character recognition from the dataset has been experimented by various machine algorithm and their accuracies has been measuring for improving the techniques in characters and digits. Earlier version of conventional Neural Networks (CNN) has to be

trained for images of each characters, digits and special symbols. It has become one of the ongoing research areas of challenge in the area of image processing and pattern recognition. It is used in various applications such as

blind reading aid, bank checks, and the conversion into structured text form of any handwritten document Using multilayer feed forward neural network it is produced to recognize characters for English alphabets without extraction of features. CNN becomes most popular for image processing in all other methods because its ability to build its own

features from raw signals and provides higher accuracy.

The allowance of comparing four main streams is based on image recognition models in KAGGLE and MNIST dataset with various divisions. Among of them CNN is changing to Capsule neural network respectively These three models are providing good accuracy for image recognition, we summarize the characters, digits and special symbols these models. CNN model exits some drawbacks and we are improving and applying CAPSNET to develop on this basis. It is the fourth model for recognizing the characters and digits we use the MNIST dataset and KAGGLE is used for special symbols. In order to address the limitations of capsule neural network we propose the solution. To reduce the complexity by introducing the multiple layers needed dynamic routing. Reducing the complexity use the number of iterations are in the initial layers in particular size. We support the better understanding of the different architecture of MNIST and KAGGLE dataset. Sequentially, we detect the capsule neural network classify each word, digit or special symbols in the image. From the viewpoint, a large number of online and offline handwritten recognition systems rely on various types of hierarchical architecture where one or many low level recognizers often deal with letter recognition as defined by different sequences of handwritten strokes. English is the main language in the world wide. More than 1billion people speaks English language worldwide. Characters and digits are having various shapes and it's really difficult to recognize those shapes. Firstly the image is pre-process because the dataset has to be recognized and then secondly segmentation is used for classifying the data and thirdly feature extraction is used for extraction of filter dataset in the images method.

2. DataSet

MNIST: The handwritten digit and character is extracted from the MNIST database. It contains of 60,000 training and 10,000 examples. It is used for training and testing in the area of machine learning .It is helpful to recognize the

digits in easier and clear process.

KAGGLE: It is mainly used for special symbols and characters in machine learning. There are 4000 training dataset and 300 is tested.

3. Related Work

SaqibAli.S and Sudha proposed a feature selection method for SVM and neural network. In this paper, digit recognition was proposed in feature selection method for SVM and neural network. It is used to identify the digits in classification of each character. Recursive feature elimination is also used to identify the in intrinsic digits. The genetic method also used to classify the symbols. It can't identify characters easily by classifying the digits. The wrapper selection is compared with RFE method to recognize the genetic algorithm.

Mindy Yang, Gary Tung introduced a Classification of segments for handwritten recognition with proposed algorithm like machine learning method and Neural network. It is used to upgrade the source with unlimited accuracy using accuracy for handwritten recognition it achieves a good accuracy using CNN, it is not excepted result. Prepare the skeleton of the character with diagonal feature work with result of the identification of character. Also, with respect to a particular task, we propose a method for finding an upper limit to the letter recognition rate to aim for

Balaji Masanamuthu Chinnathurai, Ramkrishna Sivakumar, mainly focus on the identification of mixed script handwritten word. The research community has developed many recognition algorithms like SVM, CNN (Conventional neural network). As some effort is on its way to give large test sets with standard formats, we propose an algorithm to determine a test set of reduced size that is appropriate for the task to achieve (the type of texts or words to be recognized).

Stephenn L. Rabano, Melvin K. Cabatuan, Edwin Sybingco is Performing the correct pen-holding gesture plays an important role in handwriting efficiency and quality, especially for early education. In this paper, we present the

design, implementation and evaluation of SmartWriting, which utilizes the smartwatch for pen-holding gesture recognition for both Chinese and English writing. SmartWriting can automatically identify whether the user is writing Chinese or English, based on which two classifiers are built to detect pen holding gestures by strokes in Chinese characters or English letters. In particular, we propose to leverage the combined signal of one vertical stroke and one horizontal stroke for efficient pen-holding gesture identification in Chinese writing, and wearable to infer pen-holding gesture according to any letter in English writing SVM classifier with handwritten recognition. The performance and accuracy is good. It will result and improve the quantized model for better result.

R.S.Sandhya Devi, Vijaykumar VR, M. Muthumeena mainly classified on Handwritten digits recognition is considered as a core to a diversity of emerging application. It is used widely Recognizing the numeral handwriting of a person from another is a hard task because each individual has a unique handwriting way. The selection of the classifiers and the number of features play a vast role in achieving best possible accuracy of classification. This paper presents a comparison of three classification algorithms namely Naive Bayes (NB), Multilayer Perceptron (MLP) and K_Star algorithm based on correlation features selection (CFS) using NIST handwritten dataset.

Amrutha Chandramohan, Joyal Mendonca, Nikhil Ravi Shankar present digit recognition system for handwriting using Local Binary Pattern as a feature extraction method, and K-Nearest Neighbor as a classification algorithm. This method is implemented on handwriting picture on the C1 form used by the Indonesian General Elections Commission to make it easier for the member committee to enter the result of the election into the database. This system is made up of several phases including data collection, pre-processing, and extraction including classification of features. The testing result on this system shows that the Local Binary Pattern Variance method can recognize

handwriting digit character on MNIST dataset with accuracy level 89,81% using the best parameter value radius=4,256 and 64-bin histogram, 9 region division on the image, and 10 nearest neighbor on K-NN algorithm. When tested using the data from C1 form, the system accuracy value is 70, 91%. The digits are replaced with the classification of SVM in the image processing. Separating the digits manually, which does not always work with KNN algorithm.

Andres Torres-García, Oscar Rodea-Aragón, Omar Longoria mainly presents on Handwritten digit recognition is an important subject in applications for optical character recognition and pattern-learning study. The extraction of informative features from handwritten digits for the recognition task, however, stays the most essential step towards achieving high precision. This research explores the efficacy of 4 feature extraction strategies focused on Discrete Cosine Transform (DCT) to capture and compare handwritten Digits' discriminative characteristics with classical PCA. These strategies are: DCT upper left corner (ULC) coefficients, DCT zigzag coefficients, block based DCT ULC coefficients and block based DCT zigzag coefficients. The coefficients of each DCT variant are used as input data for Support Vector Machine Classifier to evaluate their performances. The objective of this work is to identify the optimal feature extraction approach that speeds up the learning algorithms while maximizing the classification accuracy.

Sachin Hulyalkar, Rajas Deshpande, Karan Makode, Siddhant explains an offline handwritten Gujarati Digits recognition system that uses Neural Network. Data samples are gathered on A4 sized paper from various writers. We are scanned at a resolution of 150 dpi, using a flatbed scanner. On the digitized image various preprocessing operations are performed. Pre-processed image of random size is normalized to form a uniform picture of size. The density of pixels is calculated as binary patterns, and thus a vector is generated. Such features are used in Neural Network training and testing. The recognition tests for the

handwritten Gujarati digits are checked for 3 different sizes of photos 7x5, 14x10 and 16x16. We obtained 3900 samples of Gujarati digits handwritten from different people. Different pre-processing steps are applied before transferring it to the neural network on collected sample images. Algorithm is used conventional Neural network

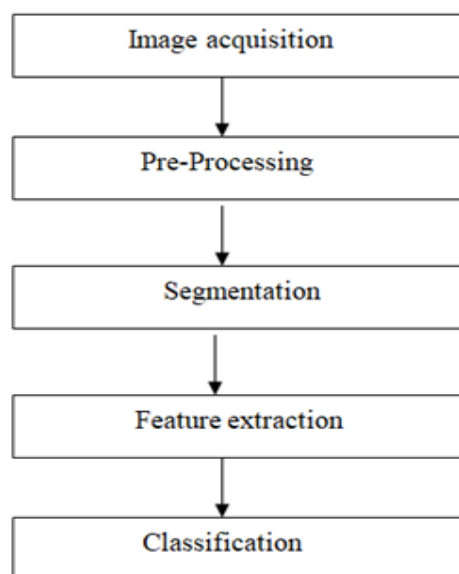
Anjali Pradipbhai Anadkat, B V Monisha, Manasa Puthineedi, Ankit Kumar Patnaik describe an advanced, offline handwritten character detection technique utilizing deep neural networking. Throughout today's world, deep neural networks have become better to instruct due to the availability of large amounts of data and numerous algorithmic advances. Nowadays, the amount of computing resources needed to instruct a neural network has grown due to the massive availability of GPUs as well as other cloud-based services such as the Google Cloud Platform and Amazon Web Services that provide resources to train a cloud-based Neural network. We developed a Handwritten Character Recognition System based on image segmentation. We used OpenCV in our program to implement Image processing, and used Tensorflow to instruct a neural network. Algorithm utilized by neural network Capsule. It is utilized to recognize the symbols. The exactness in digits cannot be stated. The second feature extraction analyzed in this research was focused on calculating and locating transition features in both vertical and horizontal directions from the background to the foreground pixels.

Olugboja Adedeji, Zenghui Wang Paper presents a new segmentation algorithm for touching handwritten digits. The proposal is divided into two parts: compilation of feature points made after skeletonization has been implemented, and the use of Self-Organizing Maps to identify the segmentation points. The approach is ideal for parallelization as these two sections are separate from one another, increasing its efficiency. The algorithm was evaluated in a synthetically linked series of 42 images of real digits and produced very promising results. The CNN is used to

classifying the all the digits and characters in detailed accuracy. It can't classify the symbols.

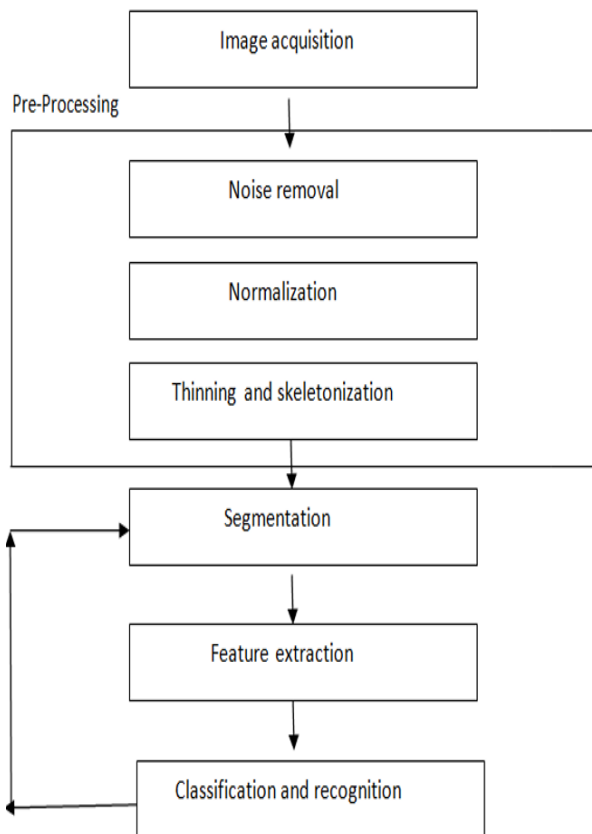
4. Existing System

The existing system is mainly based on the recognition of characters, digits and special character. They are preprocessing, segmentation, feature extraction and conventional neural network



5. Proposed Method

The suggested idea focuses primarily on identifying and classifying characters whose digits a special symbol. Our project presents an idea where a system can recognize the characters of each alphabet on its own cycle. Our current system can know on its own and in form of new symbols can constantly update itself. The benefit is that the system proposed would include all the symbols in KAGLLE dataset. A conventional neural network is employed during this project, created on Google's open source code library for dataflow programming.



They are four types of modules:

1. Pre-Processing
2. segmentation
3. Feature Extraction and
4. Conventional Neural network

6. Modules

1) Pre-processing

It is the first stage for image processing, it is utilized by means of median filtering to eliminate the noise for the image. Median filtration is a noise reduction technique. Each application requires different preprocessing techniques depending on their factors on the handwritten images.

Steps for Preprocessing

1. Binarization
2. Normalization
3. Sampling
4. De-nosing
5. Thinning

Binarization

It is the process of converting pixel images and also gray scale image into white and black.

Normalization

It is the process of converting the range of pixel with intensity value.

Sampling

It is the process of statistical analysis for digitizing the values in image pixel is called sampling.

De-nosing

It is applicable for drivers the image processing. They are two de-nosing methods

- Spatial domain de-nosing techniques
- Wavelet domain de-nosing

Thinning

It is the process of removing selected foreground pixels for the binary images

2) Segmentation

It is the process of splitting or separate the images for the handwritten character or digit recognition. They are three types of segmentation:

1. Line segmentation
2. Character segmentation
3. Word segmentation

Line Segmentation

It is the process of extraction of lines in the image. Horizontal projection used to extract lines from the documents.

Character Segmentation

In this process characters only extracted from the words. It decomposes the documents into classifiable units called characters. They are two types of character segmentation

- **Implicit Segmentation**

It is also called recognition based segmentation. It is used to split words into segments.

• **Explicit Segmentation**

The sequence of input word image is portioned into sub images of individual characters and collecting various samples of handwritten images in PNG format for binary images 0's and 1's in edge detection

Word Segmentation

It is the process of dividing a string into component words. The vertical projection profile can get column sum. By using the valleys one extract words from the line segmentation from the documents.

3) Feature Extraction

The process of gathering data from the image in handwritten recognition process. It is used to reduce the complexity of the characters and digits.

4) CNN Features and Steps Involved

1. Convolution
2. Pooling
3. Flattening
4. Full Connection

Convolution

It is a process of function and derived by two given functions which express the shape of the character or digit modifier of the given data.

Steps in CNN:

Step 1: Convolution Operation

Input image → feature detector = Feature Map

They are three elements in conventional operation

- Input Image
- Feature Detector
- Feature Map

Step 2: Pooling

Feature Map → Max Pooling = Pooled Feature Map

Types of Pooling

- Mean Pooling
- Max pooling
- Sum Pooling

Step 3: Flattening

Pooled Feature Map → Flattening → Input Layer

The pooled featured map is obtained by the flatten step. Flattening includes the transforming the entire map matrix the single column which extends the neural for processing.

Step 4: Full Connection

- Input layer
- Fully connected layer
- Output layer

7. Result

Dataset	Recognition Algorithm	Recognition Accuracy(%)
Character/Digits	SVM	90
	CNN	94
Symbols	SVM	86
	CNN	92

8. Conclusion

The classification accuracy is better than that of the benchmark dataset. Therefore it concludes that our model is adequate for solving the problem of classifying handwritten characters in the MNIST dataset as it is able to accurately categorize well with an accuracy quite also to humans. However, our model is useful in a limited domain. Some changes would have to be made to solve bigger problem of recognizing arbitrary multi-digit text in unconstrained natural images.

9. Future Scope

New features can be added to improve the accuracy of recognition. There is need to

develop the standard database for recognition. Recognition of digits in the text in other languages like Telugu and Urdu. To implement this language by using capsule neural network.

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