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Review of methods for Handwritten Character Identification using Optical Character Recognition (OCR)

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Abstract: ***It is very hard to recognize handwritten character using optical character recognition. Also it is very difficult to convert handwritten image into text format. Optical character recognition has become one of the most successful applications of technology in the field of pattern recognition and artificial intelligence. OCR is a widespread technology to recognize text inside images, such as scanned documents and photos. This paper gives the survey of different techniques used by the researcher for dynamic pattern and character recognition.***
Keywords: Dynamic Pattern Recognition, Character Recognition, English Communication Interface, Optical Character Recognition (OCR).

I. INTRODUCTION

Optical Character Recognition (OCR) [2][5][11][15] finds an important application in building the intelligent indexing systems in today's computer world. Character recognition is the learning of how machines can monitor the environment, learn to distinguish characters of interest from their background, and make sound and reasonable decisions about the categories of the character. Character recognition is becoming more important under the influence of Handwritten Character Identification HCI. Handwritten character recognition[2][3][11], a part of pattern recognition[15] is again challenging and demanding application in recent years which is widely used in public security, taxation, transportation, finance, education and other industries in the practical activities.
OCR is the technology which has been applied throughout the entire spectrum of industries, revolutionizing the document management process. OCR is the technology used to distinguish printed or handwritten text characters inside digital images of physical documents. OCR is the process with different parts that works according to the programming. A typical OCR consists of an optical scanner that scans the analog document and then each symbol and character is extracted through a location segmentation process. OCR is classified into two main domains [2]: Off-line recognition which deals with images of characters that are previously written and on-line recognition in which the writer writes directly to the system. The online problem is usually easier since more information is available. When a text document is scanned into the computer, it is converted into a bitmap, which is a picture of the text. OCR software evaluates the light and dark areas of the bitmap so as to identify each alphabetic letter and numeric digit. Hand writing is much more difficult to analyze than machine-printed characters. OCR usually involves three processes, namely text localization, character segmentation and recognition. Character segmentation is a significant step for OCR. Its efficiency depends on proper character segmentation results. The segmentation is responsible for correct recognition of the character. There are some OCR techniques used but they have many issues because of different writing styles and font sizes. Sometimes several touched typescript create problems throughout segmentation and consequently recognition error takes place. Also, the intermixed text in multilingual environment still remains a challenging problem [5].

A. Character Recognition Procedure [15]

1) *Pre-Processing:* The pre-processing stage yields a clean document in the sense that maximal shape information with maximal compression and minimal noise on normalized image is obtained.
2) *Segmentation:* Segmentation is an step that decomposes an image of sequence characters into subimages of individual characters. Segmentation is an important stage because the extent one can reach in separation of words, lines or characters directly affects the recognition rate of the script.
3) *Feature Extraction:* After segmenting the character, extraction of feature like height, width, horizontal line, vertical line, and top and bottom detection is done.
4) *Classification:* For classification or recognition back propagation algorithm is used.

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5) *Output:* Output is saved in form of text format.

B. Convolutional Neural Network [17]

Convolutional Neural Network (CNN) [17] use relatively little preprocessing compared to other image classification algorithms. This means that the network learns the filters that were hand-engineered in traditional algorithms. This independence from prior knowledge and human effort in feature design is a major advantage.

Steps involved are-

Multiply by kernel matrix to input image.

1) *Stride:* Shifting of Matrix
2) *Padding:* Assign Zero value to blank spaces
3) *ReLu (Rectified Linear Unit):* ReLU is the abbreviation of rectified linear unit, which applies the non-saturating activation function f(x)=max(0,x). It effectively removes negative values from an activation map by setting them to zero.
4) *Pooling Layer:* The Pooling layer is responsible for reducing the spatial size of the Convolved Feature

II. LITERATURE SURVEY

A. Suman Avdhesh Yadav proposed a system which gives recognition of offline handwritten English character based on Artificial Neural Network (ANN) in [1] and same method to identify the characters from United Kingdom NPs in [12]. The ANN accepts the input as a scanned image. This input undergoes a sequence of pre-processing steps like binarization and normalization. By applying the ANN on training data and the testing image we can recognize English alphanumeric characters. The subsequent steps are followed by the system to recognize the character for offline English.

Steps Followed:

1) Input the image of handwritten character for training.
2) Initialize the neural network training after size normalization and noise removal.
3) Initialize feature extraction for each data.
4) Create a database.
5) Input test image to the network.
6) Binarize the test image and extract features.
7) Match the extracted features from the stored data in the database.
8) Display results.

B. Rana S. Hussien [2] gives the Optical Character Recognition (OCR) by using Artificial Neural Networks (ANNs) classifiers. ANN was trained depending on the Hopfield Algorithm which was designed using MATLAB. The input image goes through a preprocessing stage, followed by a features extraction stage and a recognition stage. In this paper for the recognition to be correct certain properties of each of the letters are calculated, these properties also called features are extracted from the image. In this paper, following steps are followed for character recognition –

1) Image Acquisition
2) Preprocessing which includes gray-scaling, binarization and thresholding
3) Feature Extraction includes calculating number of connected components, number of holes, number of dots, position of dots, upper and lower densities, aspect ratio, extrema.
4) Classification which includes training of Hopfield neural network
5) Recognition.

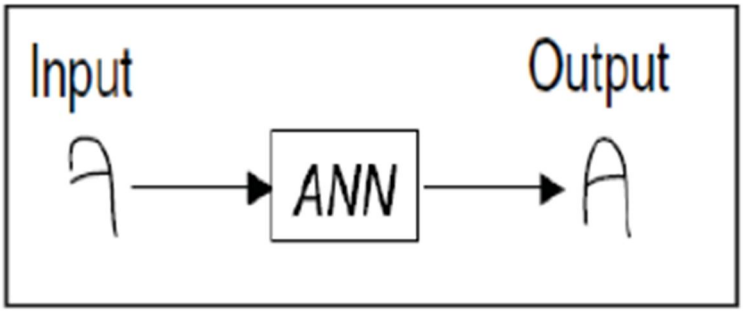


Figure: 2 Input and output of an ANN[2]

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C. Jewoong Ryu et al.[3] proposed a word segmentation algorithm for handwritten document images. With the help of a structured SVM framework. The author provides super-pixel representation methods that extract a set of candidate gaps in each text-line. Then, by formulating the assignment problem as a binary quadratic problem, which allows considering pairwise relations as well as local properties.In this paper, for character recognition following steps are followed-

1) Find out Character
2) Choose the Character
3) For using the first template size of image is rescale
4) Comparison with Template
5) Record the maximum match as a indentified character.

Ali Farhat et al.[4] proposed four algorithms applied to Qatari number plates. The four algorithms are based on feature extraction (vector crossing, zoning, combined zoning, and vector crossing) and template matching techniques. All four proposed algorithms are designed using MATLAB. Qatari binary character images were used to test the algorithms among which Template matching based algorithm shows the highest recognition rate.

Parul Sahare et al.[5] this paper gives character segmentation and recognition are presented for multilingual Indian document images of Latin and Devanagari scripts. The character segmentation technique, primary segmentation paths are discovered using the structural property of characters, whereas overlapped and joined characters are separated using graph distance theory. Finally, segmentation results are validated using highly accurate Support Vector Machine (SVM) classifier [13]. And k-Nearest Neighbor (k-NN) classifier is used, for recognizing the input character from feature vector [14].

Baoguang Shi et al.[6] proposed a novel neural network architecture, which integrates feature extraction, sequence modeling, and transcription into a unified framework. The proposed system can give end-to-end trainable, in contrast to most of the existing algorithms whose components are separately trained and tuned. The system can naturally handle sequences in arbitrary lengths, involving no character segmentation or horizontal scale normalization. The proposed system can achieve remarkable performances in both lexicon-free and lexicon-based scene text recognition tasks.

Yusuf Perwej et al.[7] express the use of neural networks for developing a system that can recognize handwritten English alphabets. Each English alphabet is represented by binary values that are used as input to a simple feature extraction system, whose output is given to our neural network system for recognition.

Sebastian Stoliński et al [10] nowadays, a lot of paper documents are transformed into electronic form, which easies information processing, like searching, analysis, and conversion. The analysis of OCR usability for automatic data entering is explained. The study is based on realistic experiments, tests, and productive utilization of the OCR systems. The experimentation was performed on two available data types: barcodes and filled text forms. With the help of this system, various types of document were tested: bank transfer forms, insurance forms, invoices, banking contract, and application forms.

S. Rishi Kumar et al.[11] proposed an efficient and real-time cost beneficial method that enables international travelers to hear the text images of sign boards, routes in their own languages. It combines the concept of Optical Character Recognition (OCR), text to Speech Synthesizer (TTS) and translator in Raspberry Pi. Text Extraction from color images is a difficult task in computer vision. Text-to-Speech conversion is a method that scans and reads any language letters and numbers that are in the image using OCR technique and then translates it into any desired language and at last, it gives the audio output of the translated text. The translate shell which is used to translate the text to is available in many languages.

III. CONCLUSION

This survey paper discusses review of all different methods used for handwritten character identification. Also in this paper, an attempt is made to present various approaches for handwritten character recognition. Here the research work of different researchers is been discussed briefly.

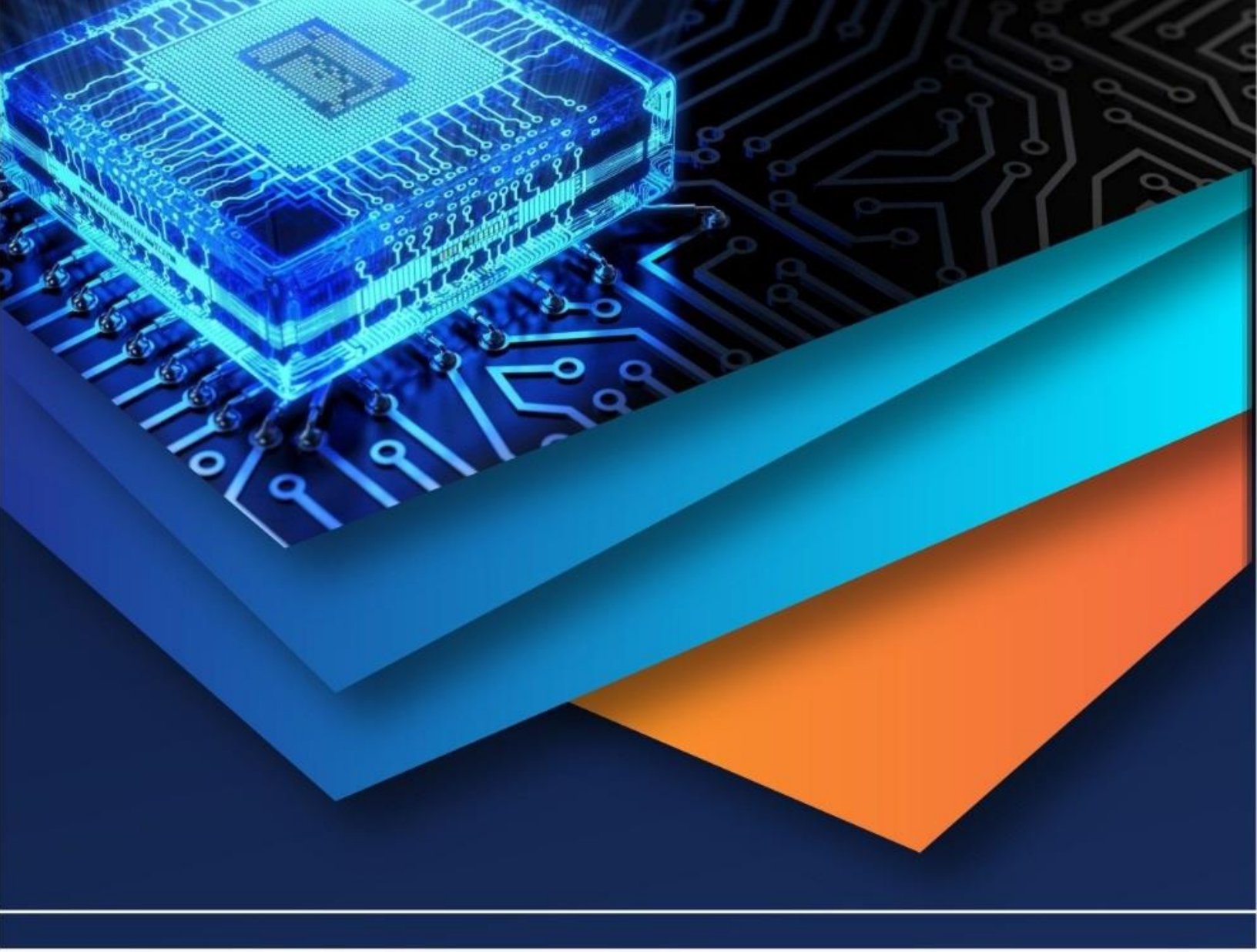
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