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A Survey on Text Line Segmentation and Drugs Recognition on Handwritten Medical Prescriptions

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A B S T R A C T

Handwriting is a skill of human that is done to express emotions, thoughts, ideas ,and language.What we write on blackboard , notebook , etc everything is handwritten and the worst and unreadable cursive handwriting owns by Doctors.In Handwritten character recognition method ,the input is scanned from images and documents which are then interpreted into digital text.In this paper discussed the method usually used in text line identification and character recognition methods.

Keywords: Handwritten Recognition,Text Line Segmentation, Offline Character Recognition, Artificial Neural Networks.

1. Introduction

Doctors play a central, critical role in maintaining the health of human being and they have been badly known for having unreadable cursive handwriting mainly because of two reasons, 1) They have to see at least 200 patients a day and will have less than 3 minutes with each patient. During this time, doctors not only write prescriptions but also at the same time they need to listen to patient's problems, diagnose for the same. 2) To avoid the misuse of medical prescriptions. It is proven that even pharmacists who distribute medicines prescribed for patients also are having difficulties with reading and interpreting doctors' handwriting due to clinical notes that are undecipherably written, and the content is unclear which resulted in many cases of medical errors and some of the reading mistakes were critical and could be lethal[1] to avoid these errors, a doctor's handwritten character recognition system is essential. In daily life whatever we write on blackboards, postal system, doctor's prescription, etc. everything is handwritten so that character recognition becomes an essential research area and the problem is yet unsolved. Every individual has different handwriting as uniqueas the personality traits; even a similar sentence is written twice by the same person the handwriting may not appear exactly the same because handwriting depends on many factors[2].

Handwritten text recognition is an important area of OpticalCharacter Recognition and Character recognition is an importantarea in image processing and pattern recognition fields.If It is a single character then recognition is easy but whenit comes with cursive and mixed cursive words, recognitionmight be difficult and challenging. Handwritten charactersdiffer by many characteristics like line or spaces betweencharacter and word, height, line quality, width and size of letters,connection strokes, shading, pen lifts, pen tip, separation,unusual letter formation, slant, baseline habits, flourishment,embellishments, and diacritic placement. External conditionsalso play a role in affecting the style of handwriting such as the types and smoothness of the paper, colors of ink, pen tiptype, table surface quality and material, personal emotions,
age, gender, and speed of the writing process [3].

A. Handwriting

The writing characteristic of a particular person is definedas handwriting also it is a behavioral biometric [4], [5], [6]characteristic, as handwriting is generated as the result of anaction accomplished by the person. It was evolved over athousand years, changing and adapting to new cultures andnew techniques. Writing is considered to have made possiblemuch of a culture and civilization.

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B. Handwriting Style

A style of writing is based on the alignment and form of characters and an efficient way of forming letters and numbers. Every individual has different handwriting styles. Characters can often seem identical, although their strokes number per column and drawing order and direction can differ substantially and depends on various other factors like pen pressure,penlifts,sizeconsistency,slant,etc.[7].

C. HandwritingNature

The handwriting data may be on on-line or off-line nature depending on how it has been made like the movement of the pen tip, taking statistics of coordinates. The scanned images of handwritten documents or just jpeg images of text are referred to as offline handwriting [8] since online recognition provides better results due to the ease with which relevant features are extracted [9]. When handwriting is being captured in real-time is referred to as online handwriting.

D. HandwritingFeatures

Handwriting characteristics are the writers' individuality characteristics [10]. Study of allograph (different character forms) and combinations of allograph (words) is the key to achieve the handwriting discriminating features [11]

E. CharacterRecognition

An interpretation of intelligible characters in a machine- processable configuration is the key to character recognition. The representation of a letter has been transformed into its corresponding character representation [12]. This is the human reading machine simulation. The character recognition task has been widely classified into two types: Machine printed documents and Hand-written documents. In machine-printed documents, the characters are straight with uniform spacing and alignment between the characters. Whereas the characters are not uniform in size in handwritten text, as well as vary in shape as the handwriting of every single human being on the earth is different [13]. The method in which a computer system recognizes symbols as well as handwritten characters in natural handwriting from sources like printing physical documents, images; and then interpret it as text also character recognition is the analysis of how machines could mingle with the environment, differentiates the character of interest from its background, and making the right character decisions. In recent years, great attention has been paid to the CR system as it has a variety of applications in computer vision, artificial intelligence,aswellasinpatternrecognition[14].

The following article is arranged as: The challenges in cursive handwriting recognition are analyzed in Section 2. Section 3 analysis the text line segmentation. In section 4, recognition of handwritten prescription using ANN. Section 5 describes some applications and Section 6 concludes for literature.

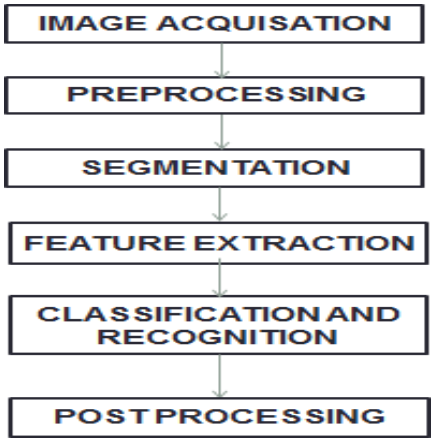

Fig. 1 - General Character Recognition System

2. Challenges in Cursive handwriting

Challenges in cursive handwriting recognition: In contrast to printed text, the automatic recognition of handwritten text is usually a tough challenge because of huge change in the writing style of the individual. The problem with cursive handwriting is compounded by the fact that the written word is ambiguous as the letters in one word are usually linked, poorly written, and may even be missing. While many typesofresearchonhandwritingrecognitionstillrecognize

3. Various Aspects of Text Line Segmentation and Text Recognition On Handwritten Medical

A. Concepts On Text Line Segmentation

A system should extract basic entities, like words, characters, or text lines, for understanding the document images' content properly. The main aim of text line segmentation is to group and spatially aligned the linked components for making a word sequence. When handwritten text is processed, line segmentation must solve those points which are rare in computer printed text like curvilinear lines, skewed lines, overlapping and touching components, fluctuating lines, irregularity of lines, line geometrical properties like the width of a line, leftmost most position, height, the distance between lines and words are among the most important ones and such attributes of handwritten documents significantly decrease the text line segmentation efficiency [18][19]. This text line segmentation process trivial with images of printed document that contain standardized types of font, character size, as well as line orientation. Several studies have been made on the segmentation and recognition of handwritten text. Based on these studies text-line segmentation and recognition using the applications of artificial intelligence areIntroduced.

1)*Weight-Gradient Feature:* In Weighted-Gradient Features processed handwritten documents of scripts considering touching lines of handwritten text. Using the canny edge operator find fine edge details of the input image and the number of zeros crossing points that are considered as a weight for each computed row [20]. Additionally, the number of zero-crossing points multiplies with gradient values, a weight-gradient image is generated. Since the gap among pixels is widened by the weight gradient image especially in the middle part of the image. To classify these inner portions into one pixel, the k means clustering technique has been used which leads into two clusters: Low mean and High mean cluster and Morphological operations are performed to fill the gap between single-pixel for avoiding disconnections. The efficiency of the method has been evaluated on various databases which are of different languages Bangala, Kannada, Oriya. The main drawback of this method is the poor result in low-quality images and attain a low accuracyrate.

2)Distance Map Features: Present a method that is binarization-free. A generic grey-scale image is processed and distance calculation is performed with floating numbers leads to a distance map, whereby value of every pixel is the shortest pathtothenearestforegroundpixel[21].

See the distance matrix of the search zone as an eight linked graph to measure this set of paths where each pixel location is a graph node. A review process is introduced fromright-to-left for re-estimating the optimal output to reach each node taking the right-hand side and the top-down outputs into accountuntil all nodes were visited by left-hand productions. The distance model method completely avoids touching lines complications because foreground pixels are not used as hard borders in the pathfinding method. This line extraction approach can be used to modern documents of historical handwritten text and handwritten and printed texts. They tested with C5 HattemManuscript and ICDAR 2013 Competition corpus. It com- prises a set of 150 pages written by different individuals independently and the C5 Hattem Manuscript is made up of 572 sheets, mostly written in Middle Dutch in a single writer manuscript from the 15th century. For evaluation, they use two scenarios first one is using ground truth baselines that can obtain an almost perfect score. The second scenario method has sufficient performance if the PRHLT-17 automated sensed baselines were used. The problems found in these baselines that they affect the results obtained by the proposed approach whenwededucefromthelessaccurateresults.

3)Seam carving method: Based on seam carving images a language-independent segmentation method was introduced for handwritten documents [22] which was used for text line segmentation, however, the image in the same document is inadequate to find multi-skewed or touching text lines there- fore a constrained seam carving approach has been proposed, it will as far as possible limit the energy transmitted in the same text line along with the linked components. The points in the background and inside the components are measured separately through distance maps, contours of all components which are extracted on the documents firstly and then Euclidean distance transform for inside the components points is measured and skeleton of components are extracted, as well as the Euclidean distance transform for background points was calculated. For enhancing the energy along withthe text lines' writing orientation, with minor and major axes an ellipse-shaped Gaussian kernel convolved Euclidean distance transform. The precision in line segmentation will be low when there is a significant intra-space between certain words. Moreover, by measuring the energy map only once from leftto right, the proposed approach attempts to extract all text lines, and the energy may be applied to each point in the following right columns which are, Seams in the vertical and horizontal orientations are extracted using the obtained energy map and all the pixels with lower energy values are linked to each seam on a line. In the experimentations, the process is verified on the ICDAR2013 Handwritten Segmentation Contest data set, contains the Indian document, English, and Greek images, and obtainedanFMscoreof98.41percent.

4)Fully Convolutional Network: FCN (fully convolutional network) for line detection in the handwritten document has beenrarelydiscussedintheliterature.FCNpresentsthe energy map which provides a better text components connection, simplifying the process of the real text lines construction [23]. The FCN approach includes no heuristic rules and hand- designed features as compare to grouping approaches. This approach, therefore, offers enhanced adaptability for various document images forms. Three FCN structures are tested, FCNpool4,FCNpool3,andFCNpool2,EachFCNincludesone convolution stream, pooling layers, and deconvolution layers, and in the first convolution layers use filter sizes 3×3 to learn early features. The string of text has beenextracted from the line map once the line map has been accessed by FCN. A string of text is referred to a pixel string whereas a line map is referred to a pixel group that matches the text field. Three main steps are taken: binarization of linemap, merging of line skeleton and extraction of line skeleton for the extraction of text, and the binarization used to mark high-score regions which indicate where text lines are to be positioned. If a part with more than one text string overlaps, consider that characters placed on multiple lines are touched. It is difficult to determine in this situation which pixel is belonging to which text line. LAG is an effective way to organize pixels into structured components at a high level.The node represents each structured component. The pixels in the touching character element may often be allocated to the appropriate text line by assigning the nodes to the closest text line. The LAG model is developed using vertical and horizontal lines on every touching text component. They have experimented on the well-recognized data set of ICDAR and produce high RA andDR.

Because of several problems in the text line segmentation, the issue is remained open, although several approaches were suggested.

4. Recognition of Handwritten Prescription Usingann

Inspired by the architecture of biological neurons, ANN (Artificial Neural Networks) comprises various processing units known as neurons. The neurons were worked together for modelling the input data and mapped it to a predened label/class. Using CNN, a handwritten character classification has been proposed by Ciresan et al. [24]. The toughest and special dataset i.e., the NIST SD 19 dataset for this reason was used with the MNIST dataset. For about 900 epochs, CNN's had been trained. The total time consumed for training is twelve hours and the accuracy was thus 75.66 percent. The nodes (neurons) are the key unit in neural networks as stated by Latif et al. In a supervised learning environment (labeled data/samples were trained), weight relative to each node is modified to scale back squared error in training samples. The computational complexity of finding weights correlated to neurons inhibited the use of neural networks initially. With the development of deep neural architectures (several a yers), such as CNN:"Convolutional Neural Networks"; andRNN: "Recurrent Neural Network", consider neural networks among the best classification method for recognition tasks including OCR [25][26][27].
Deep Convolutional Recurrent Neural Network for Hand- writing Recognition System is presented by Lovely Joy Fa- jardo et al. [28] which is generated for identifying the text in the image of handwritten doctors' prescriptions and convert cursive handwriting text into the readable text. Two models have been tested in this report, and based on the CRNN experimentation with model-based normalization system com- pared to the CRNN alone. The study shows that some image charactersmaybeconfusedwithanothercharacter.Suchasthe output provides the letter 'c' however, originally cursive letter 'e' was written in the prescription image, and for developing a Doctors' Cursive Handwriting Recognition System, this method integrates RNN and CNN as a hybrid algorithm effectively. The model could fulfill its goal of recognizing normal text script prescription. The data collected in this paper is a study of cursive handwriting by doctors from many Metro Manila, Quezon City, and Taytay, Rizal clinics and hospitals, achieve a training precision rate of 76%. The models' imple- mentation in a web application or mobile application, obtained a 72 percent validation accuracy for validating collection from the rest 540 prescription images and the mobile application has again been validated with 48 samples of handwriting were captured by researchers and out of 48 only 17 images were properly identified, which gives a validation precision of 35 percent which means average accuracy.
Anideaondeepconvolutionalneuralnetwork-basedholistic technique is conveyed by Dibyasundar Das et al. [29] and termed 'H-WordNet' for handwritten word recognition and the work has two important steps; the word images are processed in the first step and a deep CNN model has been trained in the second step for word image classification. Four convolution blocks and one FC block are part of theH- Word Net framework; a sequence of four operations have been covered in each convolution block like BN, convolution, pooling, and ReLU activation. A back-propagation algorithm is used to learn the H-Word Net framework. The stochastic gradient descent with momentum optimizer was employed for training the H-Word Net model parameters to efficiently identify the word images, leading to substantial parameter reduction. The effectiveness of various pooling operations has been studied and tested using the proposed model. This holistic CNN method avoids the requirement for handcrafted feature extraction and obtains a generalized and reliable word recognition system. This method is tested using a standard CMATER db hand written database containing images of 18000 Bangla word from 120 distinct categories and by comparing the latest state-of-the-art approaches, it has obtained a greater accuracy of96.17%.
Singh. N. [30] suggested a classification technique for hand written Devanagari characters using ANN classifier which results in 98.65 percent of accuracy. Segmentation takes place in segmented lines from top-to-bottom and individual characters from left-to-right. Each character image has been divided equally into four zones for feature extraction based on the HOG (histogram of oriented gradients). A partitioned image technique is used to generate the feature vector, which is combined with the HOG features of each zone. A feed- forward neural network is used to recognize handwritten characters. A dataset of handwritten Devanagari characters is used during the training of neural networks. This data consists of 10 handwritten sample images of each with 52 Hindi language characters, and 10-digit characters, which range from 0 to 9. 400 samples take 2.33 seconds for training data in the handwritten Devanagari character recognition. For every alphabet, the training time was 0.398 seconds and the average precision was99.27%.

5. Applications

The primary thrust field of this research is the medical do- main. Recognition of handwritten medical notes,prescriptions, etc.

A. *Historical documentrecognition*
The historical handwritten manuscripts digitalization is a world problem. The libraries and archives have increased their efforts to digitize scholars and historians written content from the past for future use. Different subfields of computer science, such as document analysis, and recognition, machine learning, computer vision, and natural language processing, text line identifications, and character recognition methods are needed to extract and index the contents of documents. In recent years, the volume of their historical document collection has increased by museums, archives, libraries, and other cultural heritage organizations, it has become very difficult to transcribe the complete text in these sets. Because Historic Document Processing covers many subdomains of computer science, it transforms images from older manuscripts into automated digital formats for data mining and information recovery systems,as well as from early printed texts.

B.*Digital markingsystem*
The evolution of the digital grading system, which grades conventional paper-based home assignments or exams as a modern mode of exam system changes. This kind of grading boasts more advantages over paper-based human evaluation. Overall grading time is reduced. The characters written by each student are different so the recognition system is much more difficult compared to printed texts. Typical single character recognition is simple but it becomes difficult in cursive answer sheets. Large answer papers may get their grading time cut in half because the essential steps are automated like: sum up the pages, flipping to the correct page, returning the exams, grades recording, etc. These automatic grading systems can help students to understand the material better because the examination questions are still fresh in mind when returning the tests.

C.Extracting data from filled informs

A major problem that almost all businesses and organiza- tions face today is the inability to leverage data that is inside scanned documents and images. Whenever a problem relies on data that is trapped inside paper documents, usually re- typing each and every data. In that case, needs an automated data entry software that helps to extract text from images and scanned documents. The challenge is not just to convert the textintheimagetomachine-readableformatbutalsoto extract it accurately This becomes even more challenging when the data inside these scanned documents and images are cursive handwriting. To accomplish the task, the use of character recognition methods and other subclasses of computer science like computer recognition, pattern recognition is used. This can be also used in the Automatic recognition of postal code, automated reading of bankcheques.

D.*Converting handwriting in realtime*

Notes on notebooks, blackboards, etc. are constantly written by people. Sometimes such notes range from a short reminder, the minutes of a meeting, a things-to-do list, to long-winded study materials. Yetinthisdigitalage,allusethispenand paper system why because the efficient replacement of paper is not discovered. In terms of affordability, efficiency, mobility, and accessibility the pen and paper method remain the champion. Digitalizing these huge handwritten notes in real-time is a benefit for organizations to save money as well as time,which are in the business world two essential things.

6. Conclusion

This research explores the different approaches used in character recognition of cursive English handwriting. Various aspects related to issues of handwriting identification are stud- ied in the present paper, like effective text line segmentation, the concept behind handwriting identification, the differences between off-line, online, and the basic facts for constructing handwritingidentification.

Over the past eight decades, there has been optical character recognition. Though, initially, products which optical charac- ters have been primarily established by large technological groups. Deep learning and machine learning developmenthave allowed individual researchers to establish techniques as well as algorithms, that can more accurately recognize handwritten manuscripts. Here mainly focuses on cursive handwriting and not any simple handwritten text. It has also been noticed that CNN (Convolutional Neural Networks) is substantially used by researchers for the recognizing machine-printed and handwritten characters. If the input in the form of the im- age then the most suited for recognition methods are CNN- based architectures. Initially, CNN has been used for object recognition tasks in images, for example,ILSVRC("ImageNet Large Scale Visual Recognition Challenge").Such CNN-based architectures that are used in visual recognition are ResNet, AlexNet, and GoogLeNet.

Future work can be done to improve the recognition speed as well as accuracy more precisely. It can be enhanced further to obtain reliable results in anoisy environment.

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