HANDWRITING RECOGNITION

Researches and industries have been looking for decades for a machine that can turn a handwriting text into a digitized set of information, they want to use this mechanism to process the digitized information. Processes like copying, pasting, deleting, sorting and other text file manipulations. Many approaches have been taken and techniques like-text segmentation, Neural Networks, and generic programming have been used to create handwriting recognizers. The handwriting recognition research has been sponsored primarily by private, commercial industries such as IBM and the US postal service. The USPS have spend billions of dollars in the research of an optimal recognizer that will help in the sorting of mail which is a big task, since billions of letters are being sorted each year. The other commercial use of handwriting recognition machines is bank check sorting, which is also an exhausting job and millions of dollars are spend in this process. There are different types of recognizers out in the market that can recognize text written in digitized panels. Taking this idea into recognizing written text in regular paper is become a major task in recognizing software and hardware developers. They have taken computer concepts and integrated into the development of these recognizing machines. Artificial Intelligent concepts like neural networks and generic algorithms, which have taken the idea of how humans recognized text in general and used this concept to develop machines that simulated this process. Building these recognizing machines is not an easy task part of the difficulty of developing these intelligent machines is that a single character can be written in so many ways. Also imperfections and variation of handwriting such as alignment, noise, and angles makes hand writing recognition difficult to implement with a machine. Do to all these imperfections in handwriting; developers have separated the problem into sub problems. This is to say that the entire process is not determine by one machine or by a single process with in a machine but by a series of processes that return some desirable result. Then a final process will combine the results from all the sub process to produce a final result. For example there is a sub process that scans the information and produces some input that then is taken by another sub process, which eliminates all the noise such as ink spots that have no mining. Then another process gives all the gaps or significant gaps between texts. Another process takes the segments of text and produces the final result.

One of the early character recognition systems used sub process to calculated loops with in individual characters and also directions of concavity and size of letters. The imperfection of handwriting in which what might be a loop in a letter, can turn out to be a writing error. Also an incomplete loop might be recognized as concavity within a character and not as a loop. There for, probability results are return instead of calculating the number of loops and directions of concavity in a character. The probability results are return with a range between 0- 100 % confidence of recognizing correctly the characteristics of the input. Then a new process will take this result and use the result to decide if the loops or concavities are taken or discarded according to their probability.

The handwriting recognizer machines also depend on there learning process, were a generic algorithm takes a given input in the training session. Then the input is incorporated in to a library where information of text segments is store for future comparisons. The library helps the entire process by compensating errors in the writing and also by deciding the acceptance or rejections of written text segments. Also a wider variety of text is accepted and the probability of making a right decision increases, as the library components are more complete. This is to say that the machine has a wider variety of segments to compare with. By teaching the machine to recognize a new character or symbol eliminates the probability of making an erroneous solution to the problem. The learning ability is achieved through a generic algorithm. Most products out in the market require a 30-minute training for good results. The learning procedure is used by both of the types of recognition systems to incorporate the learning information in to their library.

There are two main handwriting recognition systems online and offline systems. Where online systems are systems that take special stylus and are transfer from a pressure-sensitive table such as PDA. In the other hand offline systems are the ones that take input segments of text from a regular peace of paper. Although there are two different systems, both systems have the same objective, which is to convert handwritten sentences in analog form into digital form (ASCII). They used language models to recognized handwritten text (online or offline) these language models will account for informal and ungrammatical text. The Language Models are pre-written text which is store in a library and used to compare and give existing written sentences to match with the most likely of the sentences. Language Models that return values with each of the sentences are also implemented in hand writing recognition such as numerical value or probability value. N-best choice Model. Although, the recognizing machines can be trainee to

recognize new characters and extensive libraries can be built into the machine. The complexity of building good machines with very few restrictions is still a difficult task.

The complexity of a handwriting recognizer increases as the number of restrictions of what can be classified as a valid text segment or character is reduced. The probabilities of giving a correct output for a scanned text by a DRS system are very low if we don't apply restrictions. The postal service sorting machine has implemented different kinds of restrictions of what can be used as a valid input for a zip code. There can only be 5 digits +4 and the states can only be some maximum predetermine length. All this restrictions make the machines more accurate. Because handwriting machines perform better when some restrictions are apply, building a machine that will have multiple uses like: mail sorting, bank checking sorting and insurance filing and other practical used at the same time and give acceptable results with very low margins of error is difficult.

Do to the need of a multipurpose machine software that can be adjusted to the needs of a machine, a new software has been developed. One of this general context analyzer is the language called Document Specification Language (DSL), which specifies the syntax that can be recognized or be accepted by the machine. Also some of the constrains can be tuned in a dictionary which performs comparisons and returns results from the given input, giving back the most likeable of the results. Most of the new software and hardware is developed by research companies, who are sponsored by commercial companies, which in turn will beneficiate from the new technology. One of the researching companies is CEDAR (center of excellence for document analysis and recognition) which has worked in the research of document recognition in general.

One of the industries that have supported the idea of handwriting Recognition Machine development and research has been the United States Postal Service. The USPS service has sponsored CEDAR since 1987 with more than 3 billion dollars in the research of automatic machines for mail sorting. They needed a faster way to do mail sorting since more than 580 million pieces of mail are sorted every day. The research lead to the development of Remote Computer Reading (RCR) machines like H.w.a.i. (handwritten address interpretation system) for field-testing, which is use at USPS mail processing centers. H.w.a.i. its divide in sub processes such as; line separation, digit and punctuation id, word separation, shape-based classification, syntax-based classification, zip code segmentation, database queries, and word recognition. In line separation segments of the address are clustered together using local minimums. In digit and punctuation id the machine determines if the character is a digit, coma or a dash. Then the machine separates the lines of text in to words by making calculations in the spaces between characters to determine if a space really exists. In parsing the identified words are classified in to different categories such as potential zip code digits, street names, punctuations and isolated characters. Then in zip code segmentation the potential zip code is reproduce with up to 3 zip code candidates and the one with the highest probability is used. Then once the zip code is classified the RCR machines uses the library called (USPS DPF) or United States Postal Service Delivery Point File which contains a large list of zip codes, street names and States. The DPF is used to sort the letters according to its entry fields such as; city, state, zip code. Although the machine works best when the three fields are correct and complete, the machine can also compensate missing or misspelling; street names, cities, states and zip codes. Finally the machine uses the set of zip codes and street names that were retrieved from the DPF database and finds the best match between the retrieved information using a word recognizer. The CEDAR RCR uses two word recognizers Lexicon-Driven Word Recognizer (LDWR) and an Image-Driven Word Recognizer (IDWR) to identified the correct word. The RCR machine currently used yields result of 2.12 pieces per second with a 2.3% error.

Although different recognizers used different software and hardware they have similarities such as the same computer science concepts. Concepts like neural networks to classefied segments, text segmentation, and the division of processes into sub processes to achieve better results. Also most recognizers have learning capacities to learn new characters and symbols. Is important to notice how researches have taken nature in this case human perception and recognition and implemented in to machines that can perform a job faster and not necessarily better than humans.

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