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Classification of Different Segmentation Methods for Handwritten Words

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Abstract: ***For character recognition several phases is to be passed out .Very crucial, important and difficult phase is segmentation of handwritten words. Segmentation is the process of dividing the specific word into character or dividing the image or scanned document into several sub images. For performing segmentation several approaches have been described such as explicit, implicit, hybrid and holistic.This different approach works same with computer vision and neural network i.e. The segmentation is totally based on dissection. Thus dissection means dividing the image in series of sub images. There are various methods that fall in category of either computer vision or neural network. And thus the methods described below uses any of the four approaches. The methods described perform segmentation on different properties of image.***

Keywords: Segmentation, Handwritten Words, Computer Vision, Neural Network.

I. INTRODUCTION

Today in the era of machine reading, optical character recognition is on peak. Many OCR (Optical Character recognition) applications are developed. OCR in general sense means converting human handwritten text into computer readable format[3].In segmentation the image is decomposed into small sections this operation is called "Dissection"[1]. After dissection the sub images are called "Ligatures" [2] .the most well-known and general problem with segmentation is 'over segmentation' [4] [5].Over segmentation means dividing words into sections such that there is no remaining character which can be represented as a whole [5].The problem coming after over segmentation is that the whole segment is discarded [5] which can cause loss of information which seem to be important ligature. Various techniques are organized in following way:

1. ***A Classical approach:*** It is the process of cutting the word into individual sub image [1][9].The classical approach is also called explicit segmentation technique [2][9].
2. ***Recognition based segmentation:*** The image components are matched across various classes [1] [2] [9].This segmentation technique is also called implicit segmentation technique [2][9].
3. ***Holistic segmentation:*** After segmentation the word is considered as a whole [2][9].
4. ***Hybrid method:*** This methods makes use of combination of the above any methods [9].

The following sections describes various segmentation techniques based on computer vision and some of example of segmentation used with neural network as well as explicit technique, implicit technique and also holistic technique.

II. CLASSIFICATION

Table-1
Classification of Segmentation Methods Based on Computer Vision and Neural Network

Sr No	Segmentation Methods	Approach
1.	White space and pitches.	Holistic Approach
2.	Projection Analysis.	Classical Approach
3.	Connected component processing	Recognition based
4.	Landmarks	Classical Approach
5.	Hidden markov approaches	Recognition Based
6.	Non-markov approaches	Hybrid Approaches
7.	Holistic strategies	Holistic approach
8.	Enhanced Heuristic Segmenter (EHS).	Classical Approach
9.	Segmentation Path Detection (SPD)	Classical Approach
10.	Modified Direction Feature (MDF)	Recognition Based
11.	Stroke Direction (Angle) Feature Extraction	Recognition Based
12.	Segmentation Using Character Context and Fusion of Multiple Experts (SCCFME)	Recognition based
13.	Feature-based Heuristic Segmentation	Classical Approach
14.	k-means Clustering	Recognition Based.

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III. SEGMENTATION BASED ON COMPUTER VISION

A. ***Whitespace and pitch:*** It is mostly used for machine printing. As there are limited set of font each of the font or character can be covered under fixed width [1]. It is used with printed digital documents. It scans the print line twice i.e. from left to right it will scan the pitch distance and in backward scan it will segment decision [1].

B. ***Projection Analysis:*** It deals with histogram. There are two types of projection 1) vertical projection and horizontal projection. Vertical projection is nothing but a simple continuous stream of black pixel per column [1].

Fig 1.Input image for projection analysis

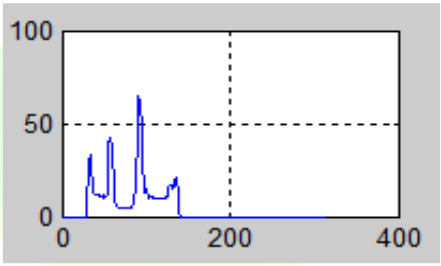

Fig 2.Vertical projection

C. ***Connected component Processing:*** It is not necessary that hand written or machine readable writing can be segmented easily. Even non touching cannot be de-segmented in a proper way. Hence the approach here is used that to determine "connected black region" [1] to combine and split the components.

D. ***Landmark:*** Using landmarks the word is divided into 3 zones. And the connected word is determined with ascenders and Descenders [1].

E. ***Hidden Markov model:*** They rely on state-to-state transition for determining probability between states. It identifies the character with state-to-state transition [1].The transition is followed from character to character. The segmented character is compared across the sequence of character generated through markov model [1].

F. ***Non-Markov Model:*** In this the evidence of existence of character is recorded. Their positions are quantified into bins such that their evidence for every character indicated in a bin can be summed to give a score for classification [1]. Then this count of bin is processed to compare against predefined lexicon to find words [1].

G. ***Holistic Strategies:*** The simple feature is extracted from whole word against the lexicons of codes that represent the theoretical shape of word. The feature is extracted based on middle zone with the help of ascenders and Descenders. The lexicon of possible word codes was obtained on the basis of transcoding table describing all the usual ways of writing letters [1] [6].

IV. SEGMENTATION USING NEURAL NETWORK

A. ***Enhanced Heuristic Segmenter (EHS):*** This algorithm finds the upper and lower baseline of word. The baseline separates the main body of the word with the overlapped strokes. Then after modified vertical histogram is used that represents the distance between the first and last black pixels in each column is generated based on the main body. At last the modified vertical histogram is normalized based on the average stroke width. Regions with values less than the average stroke width are identified as ligatures [4] [5] [6].

B. ***Segmentation Path Detection (SPD):*** The SPD initially works on ascenders and Descenders. These ascenders and Descenders are used as boundary to determine upper and middle zone. The image is divided into 4 levels. And whenever the black pixel is encountered the back traversal is made to find best fit level [4].

C. ***Modified Direction Feature (MDF):*** This algorithm works on contours and boundary. MDF is based on the location of transitions from background to foreground pixels in the vertical and horizontal directions of a binary image. Whenever a transition is located, two values are stored: the Location of the Transition (LT) and the Direction Transition (DT). An LT is calculated by taking the ratio between the location of the pixel where a transition occurs and the distance across the image in a specific direction [4]. The DT value at a particular location is also stored. The DT is calculated by examining the stroke direction of an object's boundary as defined in [4]. At last with combination of vector [LT, DT] values in each of the four possible traversal directions is created.

D. ***Stroke Direction (Angle) Feature Extraction:*** A simple technique that performs zoning to partition the image into possible stroke segments. The use of each stroke segment's centroids is to identify the angles at which the stroke components are directed. Here the 'zones' are represented by windows that have their dimensions calculated based on the size of the extracted character matrix [6].

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E. Segmentation Using Character Context and Fusion of Multiple Experts (SCCFME):

Segmentation Using Character Context and Fusion of Multiple Experts (SCCFME)

Step 1. Word is over-segmented by the Heuristic Algorithm producing Heuristic Segmentation Points (HSPs)

For each HSP:

Step 2. SAs and surrounding areas are analysed:
- A Segmentation Area (SA), centred about each HSP is extracted and processed
- The area immediately to the left of the HSP is extracted. It represents a Possible Left Character (PLC)
- An area centred about the HSP is extracted. It represents a Possible Centre Character (PCC)
- Each area is sent to a corresponding classifier for "validation"

Step 3. Classifier responses are "fused" to determine the validity of the HSP
- If the HSP is deemed "valid", based on the output obtained from classifier fusion, it becomes a Valid Segmentation Point (VSP)
- The next HSP is examined

Fig 3.Overview of procedure for segmentation using character context and fusion of multiple experts

F. Feature-based Heuristic Segmentation:

Heuristic Segmentation Procedure for a Handwritten Word

Step 1. Detection of word image boundary (contour)
Step 2. Connected component analysis
Step 3. Stroke width estimation
Step 4. Word height estimation
Step 5. Average character width estimation
Step 6. Increment an area's segmentation confidence when:
- Minima in the word's lower contour are located
- Regions of low vertical pixel density are detected

Step 7. Decrement an area's segmentation confidence when:
- Holes are detected in the word image

Step 8. Distribute segmentation points
Step 9. Remove redundant segmentation points based on proximity
Step 10. Set extra segmentation points

Fig.4 An overview of the heuristic segmentation algorithm

G. ***K-means clustering:*** Clustering means to group the image samples that have same property so that they can be classified. The K-Means clustering is a nonhierarchical clustering technique which follows a simple procedure to classify a given data set through a certain number of K clusters that are known a priori. One drawback of K-means clustering is that it can only be applied to the images that have homogenous regions with texture color [7].

V. CONCLUSION

From this survey it concludes that for image processing there are various segmentation techniques that follows different strategies. That is by using Classical approach one gets a series of sub images and those sub images can easily be compared across templates. By using implicit approaches the sub image is segmented on basis of classifier. Thus implicit approach is used where we cannot decide where the exact segmentation is to be done. When we make combination of any two methods belonging to different strategies, it becomes Hybrid strategies. The explicit strategies take less time to segment whereas implicit strategies take more time to segment.

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