

RECOGNITION OF ANCIENT CHARACTERS IN STONE INSCRIPTION

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ABSTRACT:

In our project, we simulate a technique for recognizing ancient characters in stone inscription of various centuries. Many medical mysteries and valuable historical secrets are hidden in stone inscription which only few people can understand. Though there are number of character recognition, there is no efficient system for language which has a large character set and huge amount of variation. In particular, there is no system that addresses either the morphological characteristics of stone inscriptions or accounts for ancient characters. We propose a 3-stage approach to increase the recognition efficiency of characters. The image of the sculpture is captured and converted to required dimensions. Segmentation of the character is done using Chan-veye algorithm which uses active contours for separating the characters from background. Chan-veye algorithm has resistance to the morphological characteristics of stone inscriptions as it uses active contours. The noise in the image is removed using the area property. Zoning of characters is done by which each character is divided into six regions each viz., three horizontal and three vertical regions. Feature extraction is carried out by extracting the geometric features of the character contour. These features are based on the basic line types that form the character skeleton. 54 features (nine for each region) representing the number and normalized length of line segments of is extracted. The feature vectors so generated are applied to neural network (which is trained in advance with the features extracted from the characters of training database) for pattern recognition. Post processing of the pattern obtained is done to identify the exact character.

1.OBJECTIVE: The main objective of this thesis is to convert ancient characters of various centuries to modern character by training the computer. This thesis explains how the characters are extracted and recognized using neural networks.

1.1PROBLEM DEFINITION: Though there are a number of Character Recognition systems available, Character recognition in Stone Inscription is still a challenging task due to the following factors:

- Texture of inscriptions
- Noise present in image
- Complex characters
- Matching characters of different centuries
- Large character set
- Size of letters etc.

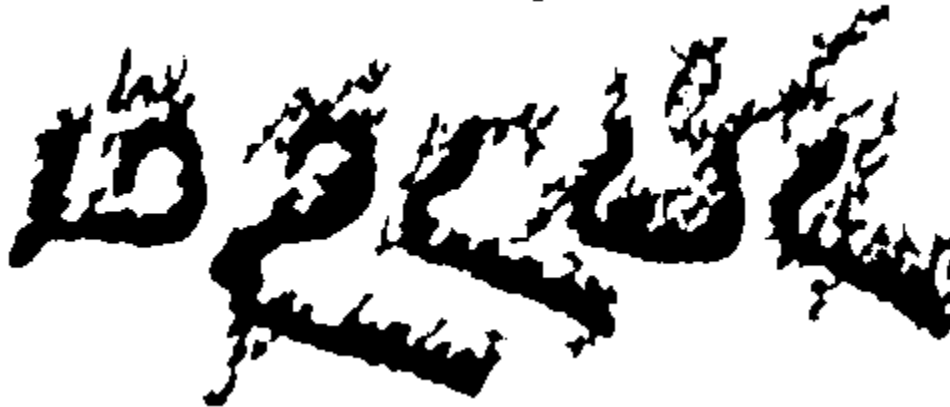
1.2EXISTING SYSTEMS:

Edge detection is performed by computing gradients in an image. The contour of points with maximum gradient forms the edges in the image. Various operators used for these systems are Sobel operator, Roberts operators, Prewitt operators, Canny operator etc. These systems cannot be applied to stone inscriptions as the surface of the stones has ruggedness.

As shown in the above figure edge detection systems cannot be used in stone inscriptions due to its texture. Also the morphological characteristics of the stone inscriptions must be addressed during segmentation. In Thresholding, the mean values of the pixel values are calculated. Then, the histogram of the image is obtained. The mean value of the pixels is applied over the histogram to obtain the threshold value. Once the threshold value is obtained, all pixels having intensity greater than threshold are converted to the value of 255 and rest of the pixels is converted to 0. By performing the above operation, Binary image of the image is obtained

having the value of 255 for characters and 0 for background of the image.

Threshold image



As shown in the above figure, when thresholding is applied the neighbours of the character is also taken as character due to the degradation function of the image. When the degradation function becomes significantly higher, the character cannot be segmented successfully.

2.PROPOSED SYSTEM :

In our project, we propose a morphological segmentation that utilises the features of adaptive thresholding combined with dilation of centroids that eliminate the disadvantages of classic thresholding methods. The various steps involved in it are

- Specifying the ROI
- Morphological segmentation
 - Conversion to Gray image
 - Adaptive thresholding
 - Applying Median filter
 - Use of Centroids
- Universe of Discourse
- Auto-correlation
- Neural networks

2.1 Specifying the ROI: Filtering a region of interest (ROI) is the process of applying a filter to a region in an image, where a binary mask defines the region. For example, you can apply an intensity adjustment filter to certain regions of an image. The multiROI function is used to obtain the region of interest from the image. The number of region of interest must be specified prior to running the program. Once it is specified, a figure window opens as shown in the image. The

required region is selected by the polygon outline. The mask representing the region of interest is formed as shown in figure. This mask is used to extract the required character from the image.



ROI Mask

2.2 Morphological segmentation: A grayscale image (also called gray-scale, gray scale, or gray-level) is a data matrix whose values represent intensities within some range. MATLAB stores a grayscale image as a individual matrix, with each element of the matrix corresponding to one image pixel. In RGB format, each pixel has three values one each for Red, Green and Blue colours. The mean value of the image for each colour are different and hence thresholding cannot be applied directly for RGB image. Hence it is converted into gray image before applying thresholding. The Gray value of the pixel can be calculated as

$$I = .3(R) + .59(G) + .11(B)$$

Where,

- I = Gray image intensity value
- R = Red component of RGB image
- B = Blue component of RGB image
- R = Red component of RGB image

Once the gray image is obtained, adaptive thresholding is done to convert it into a binary image. The histogram of the image is calculated for the image and the threshold value is calculated. All pixels having value greater than the threshold are converted into 0 and other pixels are converted into 1 as shown in figure. Median filtering is similar to using an averaging filter, in that each output pixel is set to an average of the pixel values in the neighborhood of the corresponding input pixel. However, with median filtering, the value of an output pixel is determined by the median of the neighborhood pixels, rather than the mean. The median is much

less sensitive than the mean to extreme values (called outliers). Median filtering is therefore better able to remove these outliers without reducing the sharpness of the image. The `medfilt2` function implements median filtering. A median filter is more effective than convolution when the goal is to simultaneously reduce noise and preserve edges. The noise which occupies large pixel values cannot be removed using median filter. The area property of the bounded region is used to remove these noises. The `bwlabel` function is used for implementing the above step. The command, `L = bwlabel(BW,n)`, is used which returns a matrix `L`, of the same size as `BW`, containing labels for the connected objects in `BW`. `n` can have a value of either 4 or 8, where 4 specifies 4-connected objects and 8 specifies 8-connected objects; if the argument is omitted, it defaults to 8. The elements of `L` are integer values greater than or equal to 0. The pixels labeled 0 are the background. The pixels labeled 1 make up one object, the pixels labeled 2 make up a second object, and so on. The `regionprops` command is then applied over the matrix, `L` to obtain the area of each bounded region.

The threshold of area is selected as 500 and bounded regions having area lesser than this are eliminated. The resulting image contains only the binarised characters. The region of interest mask obtained from the `multiROI` function is overlapped with the noise removed image to extract the specified character from the image. Once the required character is segmented universe of discourse function is applied over it to obtain the boundary of the character. Due to this function, the variations in the size of letters is removed as all characters will be transformed into the same size. Universe of discourse function finds the lowest number of the row that contains a non-zero element(a), the highest value of the row that contains non-zero element(b), the lowest number of the column that contains a non-zero element(c), the highest value of the column that contains non-zero element(d). These values are used to extract the required character. The required character can be now described as bounding box extending from a to b in x-direction and c to d in y-direction. The character obtained is complemented and converted to the dimension of 256 X 256 before comparing with the database to make it compatible with the images in the database.

The character after being resized is cross-correlated with every image in the database. In image processing, cross-correlation is a measure of similarity of two images as a function of a time-lag applied to one of them. This is also known as a sliding dot product or inner-product. The correlation is done in 2 dimensions and is obtained as

$$R(i, d) = \frac{E[(X_i - \mu_i)(X_d - \mu_d)]}{\sigma_i * \sigma_d}$$

Where

- 'i' is the input character
- 'd' is the image from database
- 'E' represents expectation value
- 'X' represents mean
- 'μ' represents intensity of individual pixel
- 'σ' represents the standard deviation

The above equation is applied over every pixel in each image in database. The correlated values obtained are given as input to the neural network. The neural network selects the image that has maximum correlation in the database as the recognised character.

Conclusion

The inscribed objects studied proved to be an extremely fascinating source of information for literacy and communicational strategies in the early Middle Ages. The specific character of the objects allowed access to varied levels of literacy, different from those present in manuscript production, which in the centuries under consideration was mainly restricted to the monasteries. The objects actually circulated in society, so they raised different questions concerning the nature of literacy and illiteracy in Anglo-Saxon England. As expected, the objects here analyzed showed uses of literacy ranging from simple marks of ownership to elaborate linguistic and pictorial programmes

4.References:

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