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RESEARCH ARTICLE

Iris Segmentation and Detection System for Human Recognition Using Canny Detection Algorithm

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Abstract

Iris Recognition is a highly efficient biometric identification system with great possibilities for future in the security systems to avoid future fraudulent use. Iris recognition systems obtain a unique mapping for each person. Identification of this person is possible by applying appropriate matching algorithm. In this paper, normalization segmentation is done with canny segmentation technique. Descriptive statistical analysis of different feature detection operators is performed; many features are extracted, encoded and for classification hamming distance as a matching algorithm is used. Detection of edges may help the image for image segmentation, normalization, data compression. Here we are seeing various edge detection techniques. On comparing them we can see that canny edge detector performs better than all other edge detectors on various aspects such as give better results for noisy image, remove streaking problem & adaptive in nature etc. Using minimum number of Curvelets coefficients, we can get up to 100 % accuracy and the time consumption of the system is also very low to identify iris. The Implementation and iris detection has given better results

INTRODUCTION

Security and the authentication of individuals is necessary for many different areas of our lives, with most people having to authenticate their identity on a daily basis. Biometric identification provides a valid alternative to traditional authentication mechanisms. Iris recognition is a particular type of biometric system that can be used to reliably identify a person by analyzing the patterns found in the iris. The iris is so reliable as a form of identification because of the uniqueness of its pattern. The image of eye comprises of iris, pupil, sclera, eyelid and eyelashes. The detection of the iris from the eye image can be performed by segmenting the annular portion between the pupil and sclera. Iris recognition techniques identify a person by mathematically analyzing the unique patterns of iris and making comparisons with an already existing knowledge base. The overall performance of iris recognition system is decided by the accuracy of conversion of iris features into iris code. The iris database is used to implement and test the model for the iris recognition system.

Edge detection is divided into three main steps: image pre-processing, feature extraction of iris image and template matching. Edge detection is a well developed field on its own within image processing. Edge detection is basically image segmentation technique, divides spatial domain, on which the image is defined, into meaningful parts or regions. High probability of detecting false edges and the localization error may be severe at curved edges but algorithm proposed by John F. Canny in 1986 is considered as the ideal edge detection algorithm for images that are corrupted with noise. Edges typically occur on the boundary between two different regions in an image. Edge detection allows user to observe those features of an image where there is a more or less abrupt change in gray level or texture indicating the end of one region in the image and the beginning of another. It finds practical applications in medical imaging, computer guided surgery diagnosis, locate object in satellite images, face recognition, and finger print recognition ,automatic traffic controlling systems, study of anatomical structure etc. Edge detection technique plays an important role in digital image processing and in different aspects of human life. Many edge detection techniques have been developed for extracting edges from digital images .Gradient based classical operators like Robert, Prewitt, Sobel were initially used for edge detection but they did not give sharp edges and were highly sensitive to noise image.

Edge Detection is a basic tool used in image processing, basically for feature detection and extraction, which aim to identify points in a digital image where brightness of image changes sharply and find discontinuities. The purpose of edge detection is significantly reducing the amount of data in an image and preserves the structural properties for further image processing. In a grey level image the edge is a local feature that, with in a neighborhood separates regions in each of which the gray level is more or less uniform with in different values on the two sides of the edge**.**

Material and Methods

The iris images which are color images acquired from the UPOL database. So these are converted to gray level in order to save the computational cost and storage memory. Histogram Equalization was then applied to adjust the contrast of the image. The segmentation method detects the boundaries. A segmentation method generally recommended by different researchers is to use Circular Hough Transform. It is a good method but takes a lot of time and memory for processing. The unique iris pattern from a digitized image of the eye is extracted and encoded into a biometric template using the image processing techniques. This can later be stored in the knowledge base. The unique information in the iris is represented as objective mathematical representation. This is checked against templates for resemblances. When a person wishes to be authorized by an iris recognition system, their eye has to be first photographed, and a template is created for their iris region. The template is compared with the other templates in the knowledgebase. The comparison can be made till a matching template is found and the person is recognized, or no match is found and the person is overruled. There are five main steps for the iris recognition process. The first step is the enrolment, where the eye image is captured. The next step is the segmentation of the iris from the other parts of the eye image. Normalization is the third step, in which the iris pattern is scaled to a constant size. Iris is represented as iris code in the fourth step. The classification phase is the final step, where a matching technique is used to find out the similarity between the two iris codes. Below depicts the schematic for an Iris recognition system.

Canny edge detector have advanced algorithm. It is an optimal edge detection technique as provide good detection, clear response and good localization. It is widely used in current image processing techniques with further improvements. Canny edge detection technique is then applied to the obtained smoothed image. As a result we get the major boundaries/edges of the image. The biggest connected component in the obtained image is the outer boundary of the IRIS. Hence it is termed as the outer segmentation. Canny edge detection algorithm runs in several steps. First in smoothing step, the operators blur the image to remove noise. Then in finding gradients step when operator detects the large magnitude of gradient of image it marks the edges. In non-maximum suppression step the operator only look for local maxima and marked it as edges. All the edge detection method applied by using MATLAB image processing tool. Then the operator applies threshold to determine potential edge. In final step edges are determined by suppressing all edges that are not connected to strong edge. All the edge detection method applied by using MATLAB image processing tool. After outer boundary is detected, the image portion outside the boundary is deleted because it is not the part of IRIS and hence of no use for our system .To finds the inner iris boundary, canny edge detector is applied on outer segmented image.

Canny edge detection technique is then applied to the obtained smoothed image. As a result we get the major boundaries/edges of the image. The biggest connected component in the obtained image is the outer boundary of the IRIS. Hence it is termed as the outer segmentation. A circle is then fit over that connected component to obtain the IRIS boundary. This process will give the outer boundary of the iris. Once the IRIS boundary is known range of the pupil boundary could be calculated, which is always in some ratio with the IRIS boundary. Generally the IRIS and pupil range from: IRIS/Pupil>2 and IRIS/Pupil< 4.

After outer boundary is detected, the image portion outside the boundary is deleted because it is not the part of IRIS and hence of no use for our system .To finds the inner iris boundary, canny edge detector is applied on outer segmented image. As explained earlier, iris and pupil have a radius ratio of 2. In order to provide accurate recognition of individuals, the most discriminating information present in an iris pattern has been extracted. Only the significant features of the iris have been encoded so that comparison between templates is done. In the feature extraction stage, first histogram equalization is done to enhance the iris texture in the normalized image. After this, the canny edge detector is used to extract iris texture from the normalized image. This edge detected is a 2D image and hence to reduce the dimension of feature it is converted into a 1D energy signal. Vertical projection is the method used for the conversion from 2D to 1D signal. Discrete curvelet transform is applied to this 1D energy signal. As a result a set of low frequency and high frequency coefficients are obtained. Since the high frequency coefficients do not contain any information, it is omitted and the low frequency coefficients each of which has a dimension of 64 bytes are taken as the iris templates.

Curvelets Transform returns on average 28000 coefficients/features and we cannot pass such a large number of features directly to the classifier because of two reasons; 1) due to such a large number of features, classification time and memory consumption will be increased. Many of the classifiers may not support such a large number of features. 2) Most of the coefficients may not have much diverse information of the image and hence can lead to wrong classification. To avoid these problems, we reduce the dimensionality of the features and choose the best representational features for the images using Principal Component Analysis (PCA). To avoid these problems, we reduce the dimensionality of the features and choose the best representational features for the images using Principal Component Analysis (PCA). Different number of features, ranging from 1-60, has been obtained from PCA for classification and the results have been discussed in the Performance Evaluation section. The reduced feature sequence is extracted from the iris images using PCA technique is fed to train the support vector machine (SVM) as iris pattern classifiers. The parameters of SVM are tuned to improve the overall system performance

Forty sets of eye images from UBIRIS database was taken for identification. Each set consists of two eye images of a person taken at different time. From each set a single eye image was randomly selected and its features were stored in the database. Therefore a total of 200 sets images were used for simulation. These images are called registered images since its feature is stored in the knowledge base. The main challenge in the identification is to identify the other two images in each set whose features are not stored. 200 sets of images whose features are not stored in the database are also used to test the algorithm. These images are called as unregistered images. An efficient algorithm should identify all registered images and reject all unregistered images. Performance of iris acceptance algorithm is validated using four parameters -False Rejection Rate (FRR), False Acceptance Rate (FAR), FRR is obviously the case where we judge a pattern as not the target one while it is. FAR is when the pattern is considered as the target one while it is not. Correct rejection rate is when the pattern is correctly judged as being not the target one. Finally, corrected accepted rate is when the pattern is correctly considered to be the targeted one. It was found that an optimum result is obtained at hamming distance threshold of 0.4. If hamming distance, between the iris code in the knowledgebase and the testing iris code, is less than the threshold then the person is authentic and accepted otherwise rejected as unauthorized. iris code in the knowledgebase and the testing iris code, is less than the threshold then the person is authentic and accepted otherwise rejected as unauthorized. Using MATLAB, a comparison study between different classical operators, Canny, Sobel, Prewitt, Roberts was also done. The operators were applied to the enhanced normalized image. The result shows the performance of each of the operators. It was found that the canny operator performs better than the others; in fact it was the only operator which was able to extract most of the iris texture.

Canny Edge Detection Algorithm:

Step 1: Start**:** Read the input image.

Step2: Compute Gradients**:** Edges should be marked where the gradients of the image has large.

Step 3: Non Maximum suppression**:** Only local maxima should be marked as edges.

Step 4: Threshold**:** Final edges are determined by suppressing all edges that are not connected to a very Strong edge.

Step 5: End**:** Input image resulted into edge extracted image.

Canny edge detection technique is then applied to the obtained smoothed image. As a result we get the major boundaries/edges of the image. The biggest connected component in the obtained image is the outer boundary of the IRIS. Hence it is termed as the outer segmentation. Canny edge detection algorithm runs in several steps. First in smoothing step, the operators blur the image to remove noise. Then in finding gradients step when operator detects the large magnitude of gradient of image it marks the edges. In non-maximum suppression step the operator only look for local maxima and marked it as edges. Then the operator applies threshold to determine potential edge. In final step edges are determined by suppressing all edges that are not connected to strong edge. All the edge detection method applied by using MATLAB image processing tool.

Result and Discussion

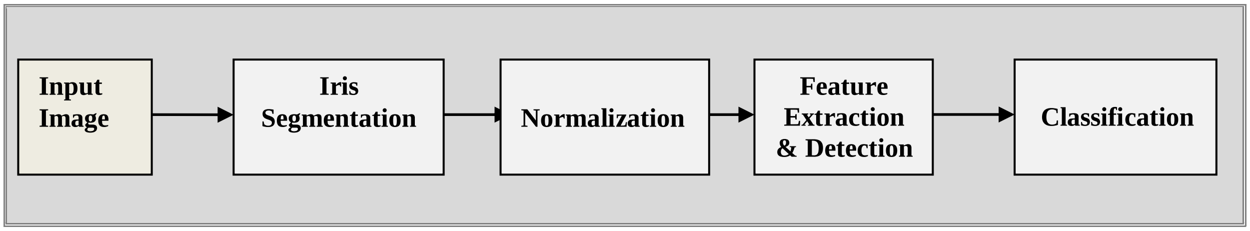
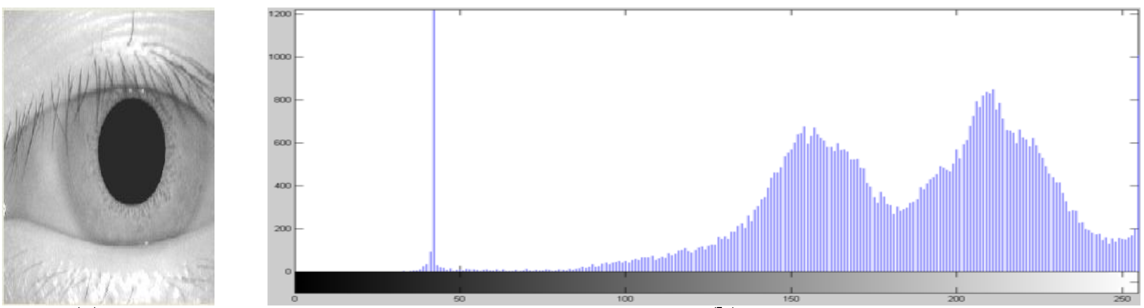
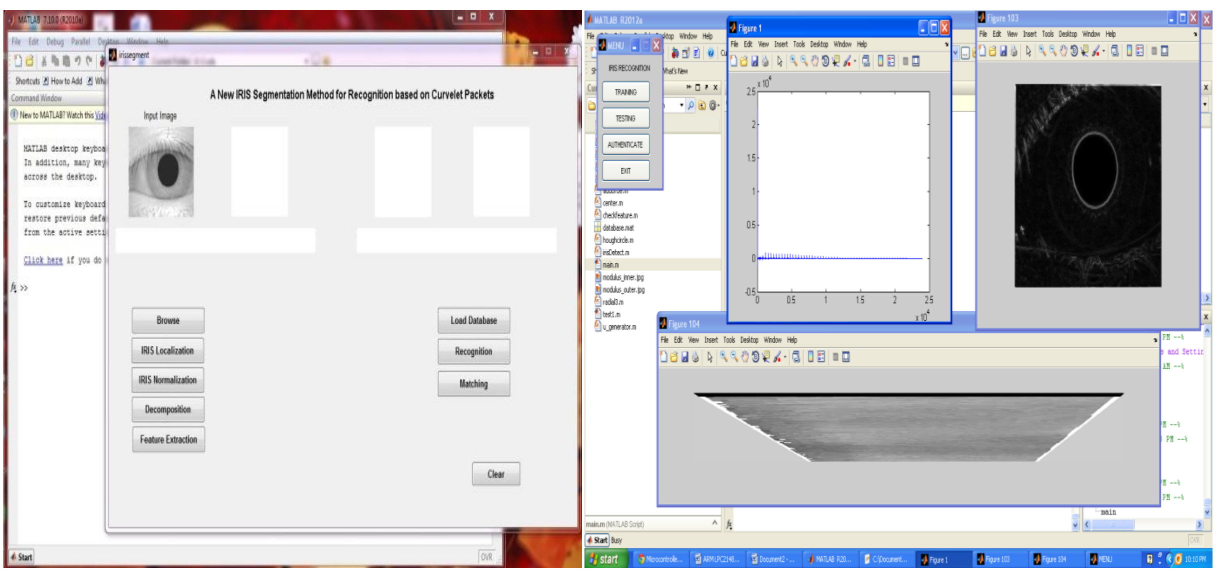


Fig. 1 **Schematic For Iris Recognition System**



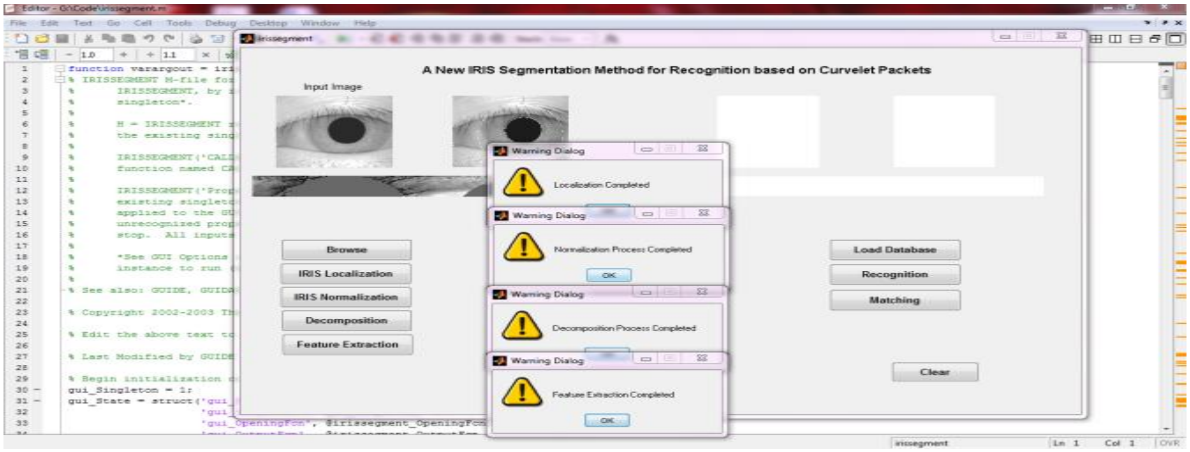
. **(a)** **(b)**

Fig. 1 (a) The Histogram applied to input image b.) histogram chart



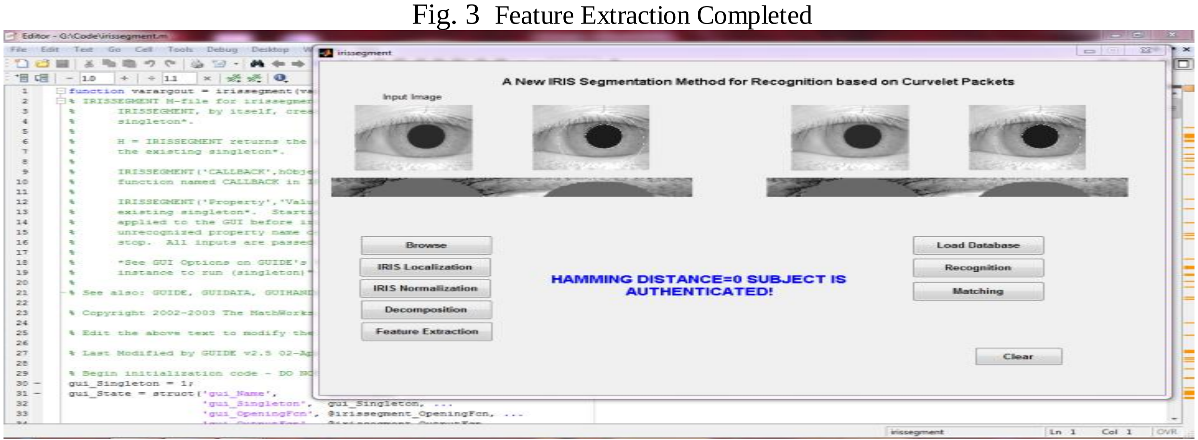
(c) **(d)**

Fig. 2 (c) Input image for iris recognition (d) Processing



(e)

Fig. 3 Feature Extraction Completed



(e)

Fig. 4 **(e)** Authenticated Responses for Iris Segmentation and Recognition System for Human Recognition

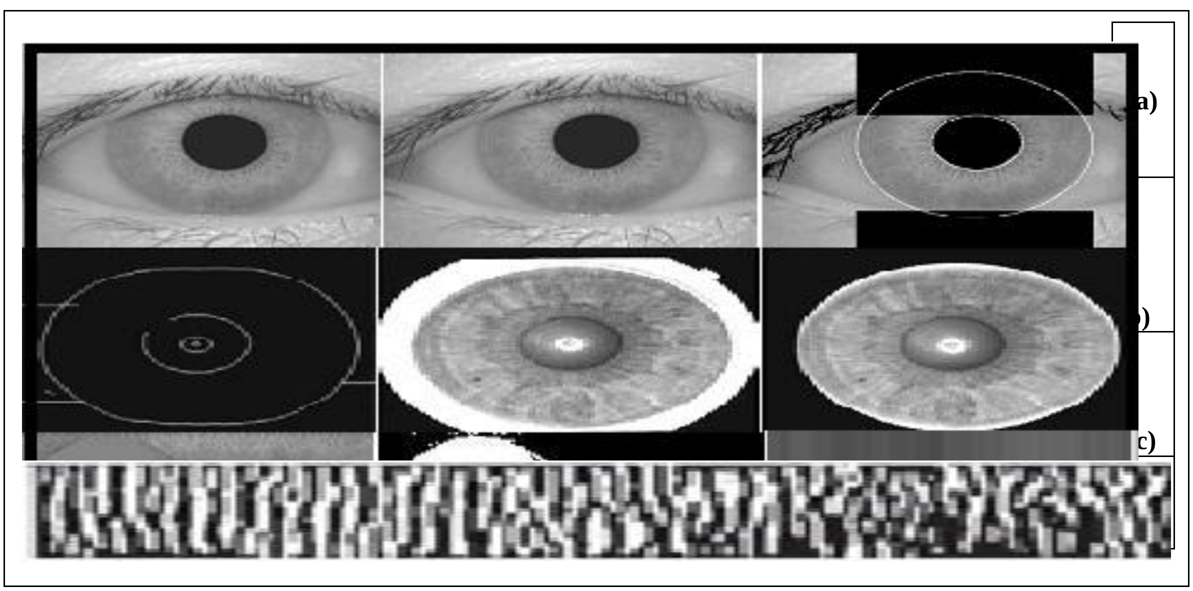
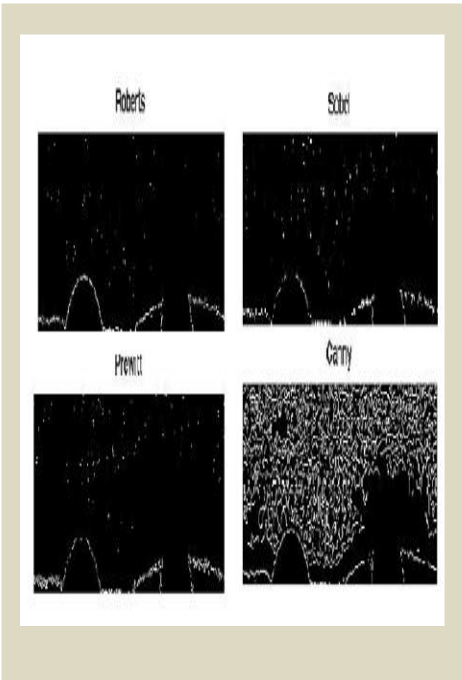


Fig. 1 Acquire Eye Image, (b) Outer Iris Circle Fitted & Segmented Iris Image (c) Normalized Iris Image (d) Encoding

(a)**Iris Detection Using Various Operators**



(b) Table 1: Statistical Report of Iris Recognition System

Performance Parameters	Statistical Parameter	Some Edge Detection Operators			
		Sobel	**Prewitt**	**Robert**	**Canny**
Success Ratio Rate (SRR)	Mean	0.53	0.53	0.56	0.81
	Standard Deviation	0.07	0.06	0.08	0.08
	Coefficient Of Variation	7.6	8.8	7.0	10.1
False Rejection Ratio Rate (FRR)	Mean	0.24	0.24	0.22	0.09
	Standard Deviation	0.25	0.23	0.23	0.10
	Coefficient Of Variation	0.96	1.04	0.95	0.9
False Acceptance Ratio Rate (FAR)	Mean	0.20	0.24	0.22	0.11
	Standard Deviation	0.23	0.25	0.23	0.12
	Coefficient Of Variation	0.86	0.96	0.95	0.91

The success, FAR and FRR of the Iris recognition are recorded for various edge detection operators -Prewitt, Robert, Sobel, and Canny. The statistical details of the success rate ratio (SRR), false acceptance ratio (FAR) and false rejection ratio (FRR) of Prewitt, Robert, Sobel, and Canny edge detection operators are listed in the above table.

Table 2: Matching Results Processed With Reduced Different Number Of Features By Principle Component Analysis To Support Vector Machines Canny Based Segmentation Using Different Sigma Values and Time Consumption Chart

No: of Features	Percentage of Accuracy	Sigma	Segmentation Accuracy	Total Images In The Database & Time for segmenting whole database	Average segmentation time for One image	Total time for Identification of Iris
5	81.2%	3.0	88.59%	200 Sets of Images & 1446.36 Seconds	3.45 Seconds	~3.89seconds
11	97.3%	4.0	90.58%	**Note:** It takes less than 3.89 seconds to segment out an IRIS from an eye image, which is much less than the computationally intensive technique of Circular Hough Transform which ~4seconds. Statistics from Table 2 shows that 18 features are enough to obtain the maximum		
15	98.6%	5.0	100%			
18	100%					

In this research work, an attempt is made to develop a simple and efficient method for iris recognition using simple segmentation method. Using 18 or more Curvelets coefficients, obtained from histogram equalized eye image database, can give up to 100 % accuracy of the recognition system. The time consumption of the system is also very low, as it can identify an IRIS within ~3.89 seconds. This time includes segmentation, feature extraction, feature detection and classification time. From the above statistical report table the mean value success ratio of Canny is greater than the other operators. The mean value of false acceptance ratio and false rejection ratio of Canny is less than other operators. The performance of an operator is said to be acceptable when the magnitude of SR is high and magnitude of FAR or FRR is low. After the successful experiments and the encouraging results achieved, it can be claimed that the proposed system is capable of fast and efficient iris identification. In the proposed system, UPQL database have been used for IRIS images. Moreover, average time consumption of the system could be improved by changing / improving the segmentation technique and other classifiers may also be used to evaluate the system.

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