A Review on Emboss and Deboss Features of Edge Matching

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ABSTRACT
Matching of the product is an importanat problem in the production industry to maintain the quality control. Emboss and Deboss are the processes of creating both raised or recessed relief images and designs in paper and other materials. An embossed pattern is raised against the background, while a debossed pattern is sunken into the surface of the material. Every Emboss or Deboss object has inner and outer boundary of the object, which may be shaped or unshaped. Therefore, the object's boundary is detected by Edge Detection using different operators like Canny, Sobel, Log, Prewitt etc. Till now, various methods available in the market are only matching objects which are following straight line and some particular shapes, i.e. square, rectangle, circle etc. So, researchers have proposed modification or investigation for Edge matching to make it proper for practical applications of unstructured shape. For Edge Matching, different similarity measures such as the Straight Line Matching Algorithm and Corner detection are used. But when the query image is unstructured, these techniques fail. In this paper, we surveyed various Edge Detection and Edge Matching techniques.

General Terms
Pattern Recognition

Keywords
Edge Detection, Contour Tracking, Edge Matching

1. INTRODUCTION
Matching is basically the selection process in which features were paired according to some measures of similarity. Edge Matching is the process of the detected edges matches between the reference image and query image. The Edge Matching process is working on three strategies: (1) Detect the edge of the reference image and query image. (2) Match the similarity between the query images with respect to the reference image. (3) Given the result of matching the edge pixels.

The detection of edges [1]–[5] is a critical preprocessing step for a variety of tasks, including object recognition [6]–[8] and Segmentation [8]–[10]. In computer vision, Edge Detection is a process which attempts to capture the significant properties of objects in the image [1]. Before Edge Detection, some preprocessing techniques apply on image like Image Conversion, Thresholding, and Morphological Operations. Object's shapes can be categorized in two groups:

(i) Structured Shape,

(ii) Non structured Shape

The object has structure, shape means that it has particular shapes like square, rectangle, circle etc. or particular straight line. And, the object has unstructured shape means that it has unspecified shape.

Many different Edge Detection and Object Matching techniques are available. It is difficult to select one out of these proficiencies. This paper gives the direction for the user to choose a suitable algorithm to resolve a problem or difficulty to a different application.

This paper is organized as follows: Section II introduces a different method of Edge Detection and its comparison. Section III is the comparison of different matching techniques. This paper is concluded in Section IV.

2. EDGE DETECTION TECHNIQUES
Pahulpreet Kaur and Dr. Bikrampal Kaur [1] presented performs that 2-D object retrieves from image shapes mentioned in the project code are identified and marked inside the recognized shape and the rest one is not recognize, which is its limitation.

Shi Guiming, Suo Jidong [2] introduced Remote Sensing Image edge detected by improved edge Canny Operator. The edge of the Remote Sensing Image has the importable own complex background. Here, authors used to Gaussian filtering and the threshold instead of compound Morphological smoothing. Using this method, the image is getting more properly without loss edge and noise. Then Otsu method can specify the threshold adaptively. In order to extract the edges of the remote sensing, image proposed an approach based on Canny edge detection operator.

Er-sen L, Shu-long Z, Bao-shan Z, Yong Z, Chao-gui X and Li-hua S [3] suggested that use the global and local, both methods used for Edge Extraction of medical skull image. The Edge Detection method that adaptive filtering improved Canny Operator combines with locally weighted k- average method, solving the problems which exist in the traditional Canny edge detection algorithm. The algorithm can extract fully skull image edge whose positioning is more accurate and no any type of disturbance.

Table 1: Comparison of different Edge detection Techniques

Techniques	Category	Role	Type of Edge	Frequency	Noise	Use of Gaussian Low pass Filter	Nature
Canny[1]–[3], [5], [11]	Derivative of Gaussian	Canny is kind of filtering method	Real weak edges can be detected	High	The noise will be less susceptible. But some edge information also will be smoothed	Yes	It is complex and better detection in noise conditions.
Edge Detection Based on Morphological Operations[5]	Non Linear Technique	It uses a certain form of structural elements to measure and extract the shape of the image	edge detected with strong noise conditions	Low	Reduce noise o r to brighten the image	No	Performance enhancement based on the cost of complexity
Sobel[12], [13]	Image Gradient Operator	Approximation of the derivative can be calculated by using two 3*3 kernels	Detected ed ges bright on a darker back-ground	High	Cannot produce good edge detection with the thin and smooth edge and less sensitive to noise	No	Calculation is fast
LoG [13], [14]	Laplacian of Gaussian edge detector	Second order Derivative to extract the edge	Testing wide area around the pixel is possible	High	Highly sensitive to noise.	Yes	The magnitude of edges degrades as noise increases due to detection of edges and their orientation.
Prewitt [15]	Image Gradient Operator	To estimate the magnitude and orientation of an edge	It can reduce the most of noise for image but the real edges of the image are mixed with much noise	High	It does not perform better in noise environment	No	Edge detection does not perform better than classical edge detector
Roberts [15]	Image Gradient Operator	To estimate absolute magnitude of the spatial gradient of the input image at that point	produces very weak responses to genuine edges	High	very sensitive to noise	No	Calculation is fast, but noise is more affected
Contour Tracking [16], [17]	Boundary Tracking	To trace the different curve of image	To track the inner and outer boundary of object image	High and Low	Less noise	Yes	It is not complex and gives better performance

Weiguo Zhang, Dan Shi and Xiaoqiang Yang [5] proposed Morphological operation for edge detection with canny edge detector. Traditional edge detectors like Canny, Sobel, Prewitt etc. can't extract the edge of the image with low frequency. Therefore, a Canny edge detector extracts the edge of the high frequency of an image and low frequency of image extracted by Morphological operations.

Longtao Zhang, Yuqiu Sun and Fushan Chen [4] introduced the Pal-King Edge Detection algorithms. In this problem of Edge Detection, improved method based on fuzzy theory and the cluster variance. Firstly, the histogram of an image is calculated and researched. If there is one peak in the image histogram, the Pal-King operator can be used to process the image directly. Otherwise, the fuzzy threshold is set to enhance the image. Secondly, the image is filtered by the Gaussian filter. Then the non-maximum suppression method is used to locate the edge and process the gradient magnitude. Thirdly, a two-threshold method is used to detect and connect the image edge.

Sheetal Israni and Swapnil Jain [12] presented license plate recognized by Sobel Operator. Generally, textures position of the boundary is a difficult task in the process of image enhancement, recognition, restoration, and compression. The Sobel Operator reduces noise from the image and makes it smooth. It calculates the magnitude and the argument value of the image and its horizontal and vertical 1st order or 2nd order gradients. At last, calculates modulus maxima along the angular direction and obtain the edge of the image. But when the image has a large amount of white Gaussian noise, it is very difficult to get the peak value of the first derivative. After, this reason Sobel enhancement operator to get a more accurate result.

Sifeng Wang, Jingxiu Zhao [14] anticipated the LoG Self-Adaptive Edge Detection Algorithm through using the entropy of gray level co-occurrence matrix. The experimental results show that the self-adaptive algorithm improves the accuracy and remove the noise.

Guowei Yang and Fengchang Xu [13] proposed new edge detection operator, Log_Sobel. The Log_Sobel operator process image with the logarithm of luminosity, it is also suited for online detection with fast execution. The Log_Sobel algorithm is used to process the image, the quality is perfect and the effect is observable. This technique is related to Prewitt operator, Robert algorithm, and Sobel algorithm. The result of the previous is much improved; the handling time is much faster.

Yeni Herdiyeni, Dicky Iqbal Lubis, Stéphane Douady [18] proposed a new algorithm for leaf shape identification of medical leaves based on curvilinear Shape Descriptor. The shape of the leaf is very hard to identify, which is which plant. Here, the authors conducted to six types of curvature edge leaf and identify the extract the edge using the Shape Descriptor.

S.Sukprasertchai and T. Suesut [11] represented the emboss characters are raised on sidewall tire of the vehicle. Canny Operator is detected the boundary of characters and recognizes by Optical Character Recognition (OCR). But, It has the limitation OCR only recognized the character, not the characterless image.

Sunil Kumar Vishwakarma, Akash, Divakar Singh Yadav [16] introduced Lane detection is challenging problems in machine vision, which depends on various ambient factors. The camera is fixed and captures the image types of roads, road structure, road texture and other obstacles like trees, passing vehicles and their shadows. Canny Edge Detection function detects the edge of structured image. Future work, the Lane detection method can further be extended to cover unstructured roads.

In table 2.1, comparison of the various Edge Detection methods of image processing is given. As compared to other, Contour Tracking is more beneficial than other methods for boundary detection. It is tracing the boundary edge of the object using image thresholding value and prevent for the noise due to the process. It is major used in the object recognize, industrial production, vision based defect detection.

3. MATCHING TECHNIQUES

Helmut Alt, Bernd Behrends and Johannes Blomer [19] described algorithm for computing the Hausdorff distance and minimize for translations and rigid motions (rotation and translation) using geometric shapes. But, it is very sensitive to noise.

Helmut Alt and Michael Godau [19], [20] identified the problem of in shape comparison and shape recognize to measure, how much two gives curves "resemblance each other". So, authors used to Frechet distance algorithm used to match, similarity (rotation, scale and translation) between both curves and Hausdorff distance, which used for translation and rigid motion (rotation and translation) using geometric shapes.

Helmut Alt and Ludmila Scharf [19]–[21] introduced the geometric shapes and curves' similarities consider to under certain transformation, scale, and rotation and match the translation and rigid motions. A few similarities measured are used for pairs of curves, which capture the course of two curves: turning function distance , dynamic time warping distance [22], Frechet distance [21]. It is applicable to the problem of complete and partial matching.

Kanuengnit Patoommakesorn, Frederic Vignat, Francois Villeneuve [17] proposed new algorithm for a new straight line matching by integration of vision based image processing. Here, Corner detector extracts the corner points of left and right corners of images, each corner use the computation of a cross-correlation, which is based on matching score. The matching comparison between corner pairs and Hough Line are able to generate a new straight on the edge of both left and right images. This simple and easy method to apply to 3D reorganization of geometric shape and gives the complete and effective result of a straight line matching process.

W. Peng, X. Hongling, L. Wenlin, and S. Wenlong [23] are modifying the traditional Harris corner detection algorithm because it is sensitive to scale and corner detect for complex background object image. Thus, it has counted on the high rate of error. The authors propose the optimized Harris corner detection algorithm. In which, firstly region is detected in the extracting target area using the Segmentation; second, corner detection by Harris corner detection algorithm for any invariance scale. This method improves the performance than the traditional method.

G. Borgefors [24] proposed Hierarchical Chamfer Matching algorithm for Edge Matching. It matches edges by minimizing a generalized distance between them. This algorithm is reasonably simple to implement and it is quite sensitive to noise. This algorithm is used for to match to gray level images of the same outlines of common tool and to match lake edge from aerial photographs of map.

Table 2: Comparison of the different matching techniques

Techniques	Rotation Invariant	Scale Invariant	Translation Invariant	Illumination Invariant	Robust against noise
Moments invariant [25]	Yes	Yes	Yes	-	Yes
Hausdorff distance Algorithm [19]–[21]	Yes	Yes	Yes	-	No
Harris Corner Algorithm [23]	Yes	Yes	No	Yes	Yes
Straight Line Matching - Hough Line Transform [17], [26]	Yes	Yes	Yes	-	Yes
Random Sampling [21]	Yes	Yes	-	Yes	Yes
Image Stitching Algorithm – Preserving Warping [22], [27]	Yes	Yes	Yes	Yes	Yes
Shape Descriptor + Shape Context [28]	Yes	Yes	Yes	-	No
SIFT Algorithm [29]	Yes	Yes	Yes	No	No
Hierarchical Chamfer Matching [24]	Yes	Yes	Yes	-	No

T. Xiang, G. Xia, L. Zhang, and R. Sensing [27] introduced the Image Stitching Algorithm, which work well for planer scenes or parallax free camera motion. With casual camera motions, variable taken views, large depth change, or complex structures, it is a challenging task for stitching these images. Therefore, Authors suggest a perspective-preserving warping for image stitching, which spatially combines local projective transformations and similarity transformation. By weighted combination scheme, our approach gradually extrapolates the local projective transformations of the overlapping regions into the non-overlapping regions, and therefore the final warping can smoothly change from projective to similarity. It has an advantage that it gives best stitching performance compared with the other method and also achieves accurate alignment in the overlapping regions.

S. Belongie, J. Malik, and J. Puzicha [28] used novel approach for shape matching. They use the novel Descriptor and Shape Context for matching the different object. The selection could be uniformly random points. To compute the distance the points of two shapes as a sum of matching error between corresponding points and measure the alignment transformation. It supports for rotation, scale and affine transformation. It has a drawback that jitter noise in the output of the matching algorithm.

S. Wei, L. Na, S. Lijuan, S. Shulin, and L. Xiangpeng [29] used SIFT algorithm with Harris corner detection for match the objects. Harris corner is detecting the corner points of the object and eliminate the edge. SIFT is invariant to image rotation, scaling and illumination and sensitive to noise.

J. Flusser [25] presented a survey of object recornition and classification methods based on image moments. In image processing, various types of moments like geometric moments, complex moments etc. and moment-based invariants rotation, scaling, affine transform, image blurring etc. Authors have used numerical algorithm to find the moment invariant by shape descriptor. But, it takes more computation time. It is shown to be robust against noise.

Table 3.1 is shown that comparison of different matching techniques with own parameters. Each technique is best for own criteria, where it should be used. Sometimes, two methods are merging or partial method concepts are used in proposal work and fulfill our requirement. Matching is important phase of industrial inspection and quality control of product.

4. CONCLUSION

Edge Matching is difficult problem for identifying boundary of object in image processing. Here, Different Edge detection and matching techniques are described with different parameters. For, Emboss and Deboss objects have own boundary, it may be inner or outer. So, Contour Tracking is best for this application. If object has particular shape or straight line than Straight Line matching algorithm and corner detection algorithm for best, as we discussed in above section. And for other object, warp perspective algorithm is better than others for matching any similarity (rotation, scaling, and translation) and invariant illumination. It is also robust for noise.

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