International Journal of Technical Research and Applications e-ISSN: 2320-8163,
www.ijtra.com Volume 4, Issue 6 (Nov-Dec 2016), PP.137-140

OBJECT IDENTIFICATION BY IMPLEMENTING CONTRARY TO LOG-POLAR MAPPING ON 2D-SILHOUETTE IMAGERY

[1] Pavani Latha Guvvu, [2] Prof. Valli Kumari Vatsavayi
[1,2] Dept. of Computer Science & Systems Engineering, Andhra University, AUCE (A), Visakhapatnam, India
[1] guvvupavanilatha@gmail.com, [2]vallikumari@gmail.com

Abstract— **Object identification is essential in several image processing and computer vision applications. Despite the fact of many existing approaches, it is still being a challenge to achieve accuracy in identification of an object. In order to identify a digital object, it has to be described by certain feature vectors. We have considered one of the shape feature vectors to describe an object in this paper. We have developed a new invariant shape descriptor, which is procured after improvisation of log-polar model. Initially, shape region of an object in the image has been considered with each and every detail with the help of centroid and maximum radius of that object. Later, a shape matrix is been generated from the proposed model and the generated shape matrix is been utilized for identification of the object. This paper also provides an overview of shape matrix descriptor along with the existing polar and log-polar mappings. A comparative analysis is made against the object mapping among existing models and the proposed model where, our model gives higher accuracy in object identification.**

Keywords— **Shape Matrix, Polar Mapping, Log-polar Mapping, Object Identification.**

I. INTRODUCTION

Digitization of images implies a need for understanding contents in an image. There are different features that provide description of objects in an image. A good feature set contains discriminating information, which can distinguish different objects. Shape of an object is an important visual feature and has a significant role in discrimination of planar objects. Shape descriptor results in some numerical representation of the original shape which analyzes the objects in an image. Efficient shape features must present some essential properties such as, identifiable, noise resistance, invariance under translation, rotation and scaling etc. The final goal of a shape descriptor is to uniquely discriminate different objects.

Our proposed method in this paper can be a promising approach in many areas such as military or defence surveillances as there is a requirement to distinguish a large set of target images such as warships and aircrafts. Our aim is to identify the object with at most accuracy and so our approach provides an efficient method to discriminate objects when compared to the existing methodologies. Experimental results of our proposed method are also provided in this paper.

II. LITERATURE SURVEY

Research in shape analysis and its extraction as a feature has been motivated by studies in [1], [2] and [3]. Several distinct doctrines on visual shape feature extractions are briefly mentioned in [1]. We also identified some promising techniques for image classification and retrieval in [2] and [3]. If a shape descriptor is able to find and retrieve perceptually similar shapes from a database accurately and efficiently, it is said to be a good shape descriptor. Shape matrix is one of the finest shape feature extraction methods and is described as an M x N binary matrix which represents a region shape. Shape matrix can represent, even shapes with holes and is also invariant under translation, rotation and scaling of an object [1]. There are shape description methods with rectangular grid sampling over an object, which is usually not invariant to translation, rotation and scaling [1], [2].

Rectangular grid sampling could be normalized to a circular raster sampling [10]. As described in [2] and [3], a normal square grid is replaced by a polar raster of concentric circles and radial lines at center of mass of an object and a shape matrix is determined to describe the object. Polar model shape matrix is represented by binary values 0's and 1's where, these values were determined by sampling the object shape at the intersections of the circles and radial lines. Polar raster formation has been extended to log-polar raster formation, which identifies an object with more accuracy.

III. EXISTING APPROACHES

Precise identification of an object is a necessary factor to identify an image accurately under essential conditions as translation, rotation and scaling. To achieve efficient identification of images in such invariant conditions, transformation of an image from Cartesian to polar is a prime factor. This transformation provides higher degree of efficiency in identifying an image.

A. Polar Model Approach

Invariance in object identification under conditions such as translation, rotation and scaling can be achieved through polar raster mapping of an image. Polar grid for an object could be viewed in (a) of figure 1. Polar transformation of an object is carried out by conversion of each Cartesian coordinate (x,y) to polar coordinate (r, θ) of that object as in equation 1.

$$r\sqrt{x^2 + y^2};\ \theta = \tan^{-1}(y/x) \qquad (1)$$

Shape matrix generation for polar raster model of an object is depicted in (b) of figure 1. In shape matrix, circles correspond to the columns and radial lines correspond to rows of the matrix. To determine the shape matrix, maximum radius of the shape to polar raster has to be figured which is equal to the radius of the circle that contains the complete shape of the object. Initiating from maximum radius and in counter clockwise direction, the values of polar model shape matrix is been considered.

Considering center of mass for figure (a) of 1, n circles were drawn with radii equally spaced and m arcs that partition the circles equally were considered. For an object, polar model shape matrix with n = 6 and m =8 is depicted in (b) of figure 1.

(a)

$$PSM = \begin{bmatrix} 0&0&0&0&0&0&0&0\\ 0&0&0&1&1&0&0&0\\ 1&0&0&1&1&0&0&1\\ 1&1&1&1&1&1&1&1\\ 1&1&1&1&1&1&1&1\\ 1&1&1&1&1&1&1&1 \end{bmatrix}$$

(b)

Figure 1: Polar model of a shape and its matrix representation. (a)Polar model grid for an object.(b) Polar model shape matrix generated.

Images that are mapped by polar raster model can determine similarity of images efficiently which are invariant of translation, rotation and scaling.

B. Log-polar Model Approach

Log-polar is a spatially variant image representation where, separation of pixels increases linearly with distance from center of mass [8]. The linear separation is executed by logarithmic calculation from center of the mass of an object. The coordinates in the log-polar raster grid are presented as (log (r), θ). By representing an image in log-polar coordinate system rather than in Cartesian coordinates, gives computational advantages over rotation and scaling of an image. In log-polar representation, inner details are sampled superior to outer details of an object as depicted in (a) of figure 2.

The principal of conversion and Shape matrix formation for log-polar model remains same as in polar mapping. But during conversion of coordinates, r will be the logarithmic value as in equation 2.

$$r = \log\sqrt{x^2 + y^2};\ \theta = \tan^{-1}(y/x) \qquad (2)$$

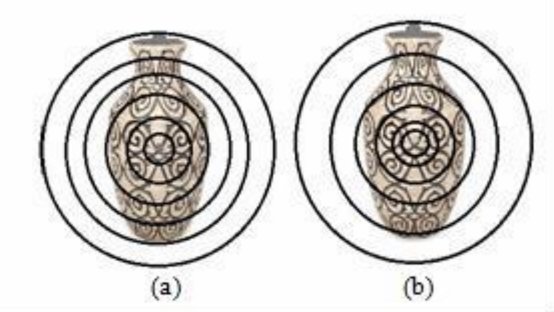

Figure 2: An object mapped by different models. (a) Polar model grid. (b) Log-polar model grid.

Recent advances in shape matrix descriptor can be viewed in [4] and [5]. Classification of images is carried by abridged shape matrices [4] which can be obtained from interpolation of inner details of shape region by polar quantization model. There are also classifications under the combinations of polar raster mapping, Fourier transformations, and nearest-neighbor classifier [6], [7]. As shape matrix extraction evolved, we can also overcome the limitations such as dependency on center of mass and maximum radius [5].

C. Drawbacks

In polar mapping of an object, inner and outer details of the object shape are been equally sampled where as in log-polar raster mapping, inner details are been oversampled than outer details of the object. As shown in figure 2, differences between polar and log-polar mapping of an object can be depicted clearly.

Consequently in both the shape feature extraction approaches, outer details of the object shape are not exhausted i.e., inner and outer details of the object are either equally preferable or the inner details of the object exceeds the outer details. These models cause less impact in identifying an object accurately. Aiming at drawbacks mentioned, a new method is been proposed that includes traditionally both outer and inner details of a shape where, outer details are more precisely defined than that of the inner details.

IV. PROPOSED MODEL

In this paper, we proposed a new method for object identification and we have extracted the shape feature that is described as the shape matrix. In figure 3 a visual simulation of an object for our method is been presented. As shown in figure 3, outer details of the object are sampled repeatedly than that of the inner details of the object which provides a robust solution in identifying the objects.

Initially, a 2-D image as in figure 3,) is directed to retrieve some very essential parameters which include, size of the image, center of mass for image i.e., centroid and maximum radius of the object. Image size determine the default values for size of the resultant image. Center of mass determines the coordinates at the centroid of an image at which the initiation of concentric circles is made. And the third of parameters, major aixs is determined to establish inevitibility of object shape region.

A digital image is usualy determined by matrix format, so the size of a 2-D image is viewed as m x n matrix where, m and n define the rows and columns of image matrix. For a image) , x and y represent the coordinates in 2-D plane where, i=1,2,3…m and j=1,2,3…n. Centroid of an image is calculated by the summons of x values and y values respectively and by using this centroid, we initiate the quantization process of an object. Major axis of an object is determined to frame the object inevitably and so we consider half in major axis as the maximum radius to form a circle which incorporates each and every detail of the object.

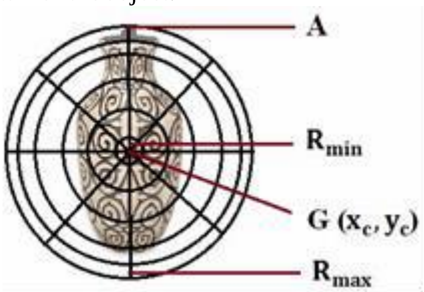

Figure 3: Contrary to log-polar model.

In figure 5,) denotes the centroid for the object through which concentric circles were formed. and are the radii of the innermost and outermost rings of the sampling pattern. and specify the number of rings and the number of sectors in the proposed raster sampling. is determined with some predefined constant and in our method it is defined as 1 and determines the field of view for the transformation. The formulae of our model relating to original positions of the target (x,y) is given in equation 3.

$$\text{Radius } (þ) = \sqrt{(x - x_c)^2 + (y - y_c)^2}$$

$$\text{Sector } (s) = tan^{-1}(y - y_c)/(x - x_c) \quad (3)$$

Algorithm for Proposed Methodology:

Input: A 2D- image.

1. Initially consider R_{min} of the object as 1 and input image size as N_r and N_w
2. Calculate circular sample condition,
   $k = (N_r - 1)/log\ (R_{max}/R_{min})$
3. Get the values of centroid $G(x_c, y_c)$ and maximum radius R_{max} of input image.
4. Calculate concentric circles radii that are to be formed, using
   Ring number (r) = $k * log\ (þ/R_{min})$
   Where,
   $þ = \sqrt{(x - x_c)^2 + (y - y_c)^2}$
5. Consider the radii of the concentric circles and invert the values.
6. Calculate the angular resolution,
   Sector number (w) = $N_w * s/(2\pi)$.
7. For p = r_m, w_n) Where, m=1, 2, N_r and n=1, 2, 3…. N_w, 2-D target image is mapped to improvised log-polar model.

Output: Target mapped to proposed method.

V. EXPERIMENTAL RESULTS

By the comparison of our result against the existing approaches, our method has a significant improvisation in identifying the target objects. By comparing the existing polar and log-polar models with our proposed model, a monumental increase is obtained in identification of targets accurately. We have represented the increase in accuracy through a plotted graph in figure 4.

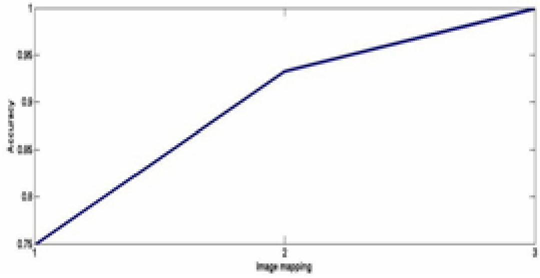

Figure 4: Graph plotted by similarity measure obtained for polar, log-polar and improvised log-polar techniques.

On the x-axis, 1 represents the polar mapping of an object in an image and its similarity measure is defined on y-axis and in similar, 2 and 3 on x-axis represents log-polar mapping and our proposed model to the similar image. This graph proves the increase in accuracy obtained through our proposed model.

CONCLUSIONS

Shape feature based searching of images has attracted much attention in several areas. In this paper, a new approach has been proposed for identification of images which are mostly preferred as targets. Our approach has a capability to identify an image with at most accuracy when compared to existing models. Our proposed method in this paper can be a promising approach in applications such as defence systems for identification of target objects as there is a need to distinguish a large number of target images such as warships and aircrafts in military surveillance. A comparative analysis for our proposed model against the existing models is also been made in which, our proposed method shows high degree of accuracy in identifying the objects. The proposed model is invariant under translation, rotation and scaling. A significant advantage for our proposed method includes good retrieval accuracy.

REFERENCES

[1] G. Eason, B. Noble, and I. N. Sneddon, “On certain integrals of Lipschitz-Hankel type involving products of Bessel functions,” Phil. Trans. Roy. Soc. London, vol. A247, pp. 529–551, April 1955. (references)

[2] Y. Mingqiang, K. Kidiyo, R. Joseph, A Survey of Shape Feature Extraction Techniques. Pattern Recognition, IN-TECH, pp.43-90, 2008.

[3] Z. Dengsheng, Lu. Guojun, Review of shape representation and description techniques. Pattern Recognition, Volume 37, Issue 1.

[4] L. Sven, A Survey Of Shape Analysis Techniques. Pattern Recognition, Vol. 31, No. 8, pp. 983Ð1001, 1998 Pattern Recognition Society. Elsevier Science Ltd

[5] H. K. Kondaveeti and V. K. Vatsavayi, "Robust ISAR image classification using Abridged Shape Matrices," 2016 International Conference on Emerging Trends in Engineering, Technology and Science (ICETETS), Pudukkottai, India, 2016, pp. 1-6.

[6] V. K. Vatsavayi, H. K. Kondaveeti, Efficient ISAR image classification using MECSM representation. Journal of King Saud University – Computer and Information Sciences (2016)

[7] S. h. Park, J. h. Jung, S. h. Kim and K. t. Kim, "Efficient classification of ISAR images using 2d fourier transform and polar mapping," in IEEE Transactions on Aerospace and Electronic Systems, vol. 51, no. 3, pp. 1726-1736, July 2015.

[8] K. Kyung-Tae, S. Dong-Kyu and K. Hyo-Tae, Efficient Classification of ISAR Images. IEEE transactions on antennas and propagation, vol. 53, no. 5, may 2005 1611.

[9] Q. Wang et al., "An Algorithm of Inverse Log Polar Transform Based on Neighbor Pixels," Image and Signal Processing, 2009. CISP '09. 2nd International Congress on, Tianjin, 2009, pp. 1-5.

[10] T. Peli, "An algorithm for recognition and localization of rotated and scaled objects," in Proceedings of the IEEE, vol. 69, no. 4, pp. 483-485, April 1981.

[11] A. Goshtasby, "Description and Discrimination of Planar Shapes Using Shape Matrices," in IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. PAMI-7, no. 6, pp. 738-743, Nov. 1985.