Global Journal of Enterprise Information System
DOI: 10.18311/gjeis/2018/20660

Design of Computer Vision System for Objects Recognition in Automation Industries

Tushar Jain[1]*, Meenu[2] and H. K. Sardana[3]

[1]Mechanical Engineering Department, MIET Meerut, Meerut, Uttar Pradesh, India; tusharkaid@gmail.com

[2]Mechanical Engineering Departments, NIT Kurukshetra, Thanesar, Haryana, India; menu_1625@ymail.com

[3]Central Scientific Instrument Organizations (CSIO), Chandigarh, Punjab, India; hk_sardana@hotmail.com

Abstract

The field of machine vision has been developing at quick pace. The development in this field, dissimilar to most settled fields, has been both in expansiveness and profundity of ideas and procedures. Object recognition is widely used in the manufacturing industry for the purpose of inspection. Mechanically manufactured parts have recognition difficulties due to manufacturing process including machine malfunctioning, tool wear, and variations in raw material. This paper considers the problem of recognizing and classifying the objects of such parts. RGB images of different objects are used as an input. The Fourier descriptor technique is used for recognition of objects. Artificial Neural Network (ANN) is used for classification of different objects. These objects are kept in different orientations for invariant rotation, translation and scaling. Invariant example acknowledgment utilizing neural systems is an especially appealing methodology on account of its closeness with natural frameworks. This paper shows the effect of different network architecture and numbers of hidden nodes on the classification accuracy of objects.

Keyword: Artificial Neural Network, Computer vision, Fourier descriptors, Image processing, Object recognition

Paper Code (DOI): 20660; **Originality Test Ratio:** 11%; **Submission Online:** 29-Mar-2018; **Manuscript Accepted:** 31-Mar-2018; **Originality Check:** 03-Apr-2018; **Peer Reviewers Comment:** 13-Apr-2018; **Double Blind Reviewers Comment:** 20-Apr-2018; **Author Revert:** 23-Apr-2018; **Camera-Ready-Copy:** 27-Apr-2018; **Editorial Board Excerpt:** 30-Apr-2018.

Editorial Board Excerpt: *Initially at the Time of Submission (ToS) submitted paper had a 36% plagiarism and after rectification it was reduced to 11%, which is an accepted percentage for publication. The editorial board is of an observation that paper had a subsequent observation by the blind reviewer's which at a later stages had been rectified and amended by an author in various phases as and when required to do so. The reviewer's had in an initial stages comment with minor revision with a following remark which at a short span restructured by an author. The comments related to this manuscript is extremely noticeable both subject-wise and research wise by the reviewers during evaluation and further at blind review process too. All the comments had been shared at a variety of dates by the authors' in due course of time and same had been integrated by the author in addition. By and large all the editorial and reviewer's comments had been incorporated in a paper at the end and further the paper had been earmarked and decided under* ***"View Point"*** *category as its highlights and emphasize the work in relation to Design of Computer Vision System for Objects Recognition vis-à-vis automation industries.*

1. Introduction

Object recognition is an amazing human feat. An attempt to develop a machine to mimic human capability is the starting point of object recognition. The term 'recognition' has been used to refer to many different visual abilities, including identification, categorization, and discrimination. Humans effortlessly recognize objects within a fraction of second. People have an exceptional capacity to figure out what things are by essentially taking a gander at them. Unlike computers, humans can easily recognize a face, understand spoken words, and distinguish different styles of handwriting. An attempt to develop a machine to mimic human capability is the starting point of object recognition. The question acknowledgment is a standout amongst the most principal issues of picture handling[18]. Due to the significant variations exhibited by the diversified real world patterns, it is a testing issue against the conflicting brightening, fractional impediment, changing foundation and moving perspective. Programmed (machine) acknowledgment, depiction, arrangement, and gathering of examples are imperative issues in an assortment of designing and logical controls. Invariant example acknowledgment utilizing neural systems is an especially appealing methodology on account of its closeness with natural frameworks[6]. Protest acknowledgment should be possible by utilizing a neural

*Author for correspondence

framework that consolidates parts of human question acknowledgment, together with established picture preparing strategies[5]. Invariance via preparing is accomplished by showing the system a predefined set of examples under various changes, for example, revolution, translation etc. Object recognition is widely used in the manufacturing industry for the purpose of inspection.

2. Literature Review

Fourier Descriptors (FDs) were at first proposed in 1960[2]. FDs are among the most well known shape depiction methods for vision and example acknowledgment applications. FDs allude to a class of techniques, not a solitary strategy, since there are a wide range of manners by which the FDs of a shape can be characterized. Chellappa and Wallace[1,16] used Fourier descriptor for the recognition of objects. The FD is gotten by applying a Fourier change on a shape signature. Another Fourier-based descriptor for the portrayal of the shapes for recovery reasons for existing is presented[11]. This descriptor consolidated the advantages of the wavelet change and Fourier change. Along these lines the Fourier descriptors could be exhibited in different scales, which enhance the shape recovery exactness of the regularly utilized Fourier descriptors. A novel Fourier descriptor (FD) was proposed which was derived from Chord-Length Functions (CLF) obtained through equal-arc-length partitions of a contour[17]. The Fourier descriptor is also suggested as a matching method which was invariant against rotation, expansion, contraction, and translation for object recognition[4]. The structure and weights of ANN were tuned with utilization of transformative idea. In this work pixel-by-pixel shine preparing was embraced with utilization of ANN worldview. A structure for question portrayal in view of fluffy divided charts is discussed[12]. A cross breed approach for picture division in light of the thresholding by fluffy c-implies is exhibited (THFCM) calculation for picture division[8]. A category-independent shape prior for object segmentation introduced[10]. Background elimination technique is used to identify the object[3]. A novel and fast interactive image segmentation algorithm was proposed for use on mobile phones[15]. A disconnected mark acknowledgment and confirmation framework is displayed which depends on minute invariant strategy and simulated neural system (ANN)[14]. Six different FDs were compared which are derived from different shape signatures[20]. An exploratory correlation of shape order techniques was done in view of autoregressive demonstrating and Fourier descriptors of shut forms[9]. Outline shapes from non-blocked 2D objects pivoted, scaled, and interpreted in 3D space were extricated[7]. Another strategy was displayed to separate face from non-confront pictures utilizing Fourier descriptors.

3. Steps for Object-Recognition Systems

Figure 1 shows a block diagram of pattern recognition system.

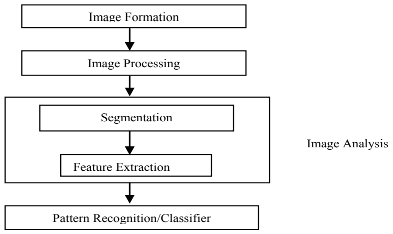

Figure 1. Pattern recognition system.

4. Proposed Method

The overall goal of this paper is to propose algorithms for feature based recognition of 2D parts from intensity images. Most present computer vision systems are custom-designed systems, which can only handle a specific application. This is not surprising, since different applications have different geometry, different reflectance properties of the parts.

5. Image formation

Images are captured with various rotations, scaling and translation. Three objects are taken for classification. Total 80 images of all objects are taken to develop a data set. Figure 2 shows different images of mechanical objects.

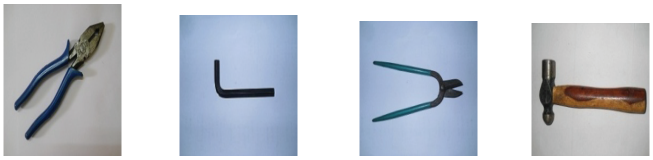

Figure 2. Different images of mechanical objects.

6. Image Processing

For image processing median filter is used. In this filter, value of each pixel is replaced by the median of all the values in the local neighborhood. 3*3 averaging kernel often used in median filtering. The dimension of neighborhood N controls the amount of filtering. Large filter means greater smoothing but loss in image detail results. Figure 3 shows the 3 × 3 mask.

(I-1,J+1)	(I,J+1)	(I+1,J+1)
(I-1,J)	(I,J)	(I+1,J)
(I-1,J-1)	(I, J-1)	(I+1,J-1)

Figure 3. The 3 × 3 mask.

7. Enhanced Images

Figure 4 shows the enhanced image of one object using median filter.

Figure 4. Enhanced image of one object.

8. Image Segmentation

For segmentation of images Otsu method is used[13]. Threshold is found that limits the intra class difference that is defined as a variance of weighted sum of two classes. Figure 5 shows the segmented image of one object.

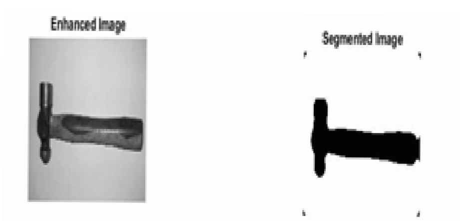

Figure 5. Segmented image of one object.

9. Features Extraction

The proposed shape descriptor is inferred by applying two-dimensional Fourier change on a polar-raster inspected shape picture. Because 1D Fourier descriptor cannot capture shape interior content this is important for shape discrimination. The knowledge of shape boundary is required for 1D Fourier descriptor. The obtained shape descriptor is application free and hearty. It has been demonstrated that shape portrayal utilizing FD beats numerous other form shape descriptors. It catches shape better highlights in both spiral and roundabout bearings. The ghastly highlights of a picture are typically briefer than the highlights extricated from spatial area. Turn invariance of a shape is critical in light of the fact that comparable shapes can be under various introductions[19].

The persistent and discrete 2-D Fourier change of a shape picture f (x, y) (0<=x<M, 0<=y<N) are given by Equation (1).

$$F(u,v) == \sum_{x=0}^{M-1}\sum_{y=0}^{N-1} f(x,y) \times \exp\left[-j2\pi ux/M + vy/N\right] \quad (1)$$

10. Effect of Changing Network Architecture

In order to observe the effects of different network architecture, numbers of hidden nodes taken are 5, 10, 20, and 30. The learning rate is set to 0.1, and force term utilized is 0.2. Table 1 shows the variation of overall accuracy with different network architectures. As can be seen from Table 1 20 hidden nodes network structure produced the best results at 1000 iterations (90.5 % accuracy based on overall accuracy and 87.50% based on kappa coefficient). So 20 hidden nodes are selected for further analysis. One important finding is that there is not any considerable change in the network performances after 1000 iterations. The use of 30 hidden nodes did not have any critical impact on the system's execution; in fact it slightly produces worse results.

Table 1. Effect of hidden nodes on overall accuracy and kappa accuracy for data

Number of Iterations (N)	Network Structure							
	52-5-4		52-10-4		52-20-4		52-30-4	
N	(O)%	(K)%	(O)%	(K)%	(O)%	(K)%	(O)%	(K)%
500	86	82.5	88	85	90	87.5	90	87.5
1000	87	83.5	89	86	90.5	87.5	90	87.5
1500	86	82.5	88	85	90	87.5	88	85
2000	86	82.5	88	85	88	85	88	85
2500	86	82.5	88	85	88	85	88	85
3000	86	82.5	88	85	88	85	88	85

11. Testing of Images

After calculating the variation of overall accuracy with different network architectures and the results of different configuration of the sample size of 40 testing images are taken. Table 2 shows the results of the confusion matrix obtained on these testing samples of objects.

Table 2. The confusion matrix of testing samples of objects

=== Confusion Matrix ===

	a	b	c	d	<-- classified as
a	9	1	0	0|	a = Object1
b	1	9	0	0|	b = Object2
c	0	0	10	0|	c = Object3
d	0	0	0	10|	d = Object4

12. Conclusion

Classification accuracy is affected by the learning rate and momentum term. ANN is computationally demanding and slow. 20 hidden nodes network structure produced the best results at 1000 iterations (90.5 % accuracy based on overall accuracy and 87.50% based on kappa coefficient). So 20 hidden nodes are selected for further analysis. The learning rate is set to 0.1, and momentum term used is 0.2 gives the best results architectures. The confusion matrix also shows the accuracy of the classifier.

13. References

1. Chellappa R, Bagdazian R. Fourier coding of image boundaries. IEEE Transactions on Pattern Analysis and Machine Intelligence. 1984; 1:102–5. https://doi.org/10.1109/TPAMI.1984.4767482
2. Cosgriff RL. Identification of shape. Report No 820-11 of the Ohio State University Research Foundation; 1960.
3. Deore SS. Object Detection using Background Elimination. International Journal of Graphics and Image Processing. 2013; 3:35–9.
4. Itoh H, Hirata T, Member NI. Machine parts recognition and processing using fourier descriptors. Systems and Computers in Japan. 2007; 20:26–36. https://doi.org/10.1002/scj.4690200803
5. Jain T, Meenu. Computer vision: An enterprise of industrial automation and integration. Advances in Modeling, Optimization and Computing. 2011; 1:10–5.
6. Jain T, Meenu. Automation and integration of industries through computer vision systems. International Journal of Information and Computation Technology. 2013; 3:963–70.
7. Jain T, Meenu, Sardana HK. Mechanical CAD parts recognition for industrial automation. Springer SIST; 2017; 2:1014–9.
8. Jassim FA. Hybrid image segmentation using discerner cluster in FCM and histogram thresholding. International Journal of Graphics and Image Processing. 2012; 2:241–4.
9. Kauppinen, Hannu, Seppanen T, Pietikainen M. An experimental comparison of autoregressive and fourier-based descriptors in 2D shape classifications. IEEE Transactions on Pattern Analysis and Machine Intelligence. 1995; 17:201–7. https://doi.org/10.1109/34.368168
10. Kim, Jaechul, Grauman K. Shape sharing for object segmentation. Computer Vision–ECCV. 2012; 444–58.
11. Kunttu I. Multiscale fourier descriptor for shape-based image retrieval. IEEE Pattern Recognition. 2004; 2:44–9. https://doi.org/10.1109/ICPR.2004.1334371
12. Malmberg F, Lindblad J, Sladoge N, Nystrom I. A graph-based framework for sub-pixel image segmentation. Theoretical Computer Science. 2011; 412:1338–49. https://doi.org/10.1016/j.tcs.2010.11.030
13. Otsu N. A threshold selection method from gray-level histograms. Automatica. 1975; 11:23–7.
14. Oz C, Ercal F, Demir Z. Signature recognition and verification with ANN. IEEE Transaction on Pattern Analysis and Machine Intelligence. 2004; 2:401–11.
15. Prasad KV, Gandhi GS, Balaji S. Inexpensive colour image segmentation by using mean shift algorithm and clustering. International Journal of Graphics and Image Processing. 2014; 4:260–6.
16. Wallace, Timothy P, Wintz PA. An efficient three-dimensional aircraft recognition algorithm using normalized fourier descriptors. Computer Graphics and Image Processing. 1980; 13:99–26. https://doi.org/10.1016/S0146-664X(80)80035-9
17. Wang B, Chaojian S. A novel fourier descriptor for shape retrieval. Fuzzy Systems and Knowledge Discovery. 2006; 822–25. https://doi.org/10.1007/11881599_101
18. Ye Z, Ye Y, Yin H, Mohamadian H. Integration of wavelet fusion and adaptive contrast stretching for object recognition with quantitative information assessment. ICGST-GVIP Journal. 2009; 8:5–17.
19. Zhang D, Guojun L. Shape-based image retrieval using generic fourier descriptor. Signal Processing: Image Communication. 2002; 17:825–48. https://doi.org/10.1016/S0923-5965(02)00084-X
20. Zhang D, Guojun L. Study and evaluation of different fourier methods for image retrieval. Image and Vision Computing. 2005; 23:33–49. https://doi.org/10.1016/j.imavis.2004.09.001

Annexure-I

Design of Computer Vision System for Objects Recognition in Automation Industries

ORIGINALITY REPORT

11%

SIMILARITY INDEX

PRIMARY SOURCES

1	scholar.lib.vt.edu Internet	32 words —	2%
2	dspace.cc.tut.fi Internet	30 words —	2%
3	Bin Wang. "A Novel Fourier Descriptor for Shape Retrieval", Lecture Notes in Computer Science, 2006 Crossref	29 words —	2%
4	B.J. Jain, F. Wysotzki. "Multi-layer perceptron learning in the domain of attributed graphs", 2004 IEEE International Joint Conference on Neural Networks (IEEE Cat. No.04CH37541), 2004 Crossref	23 words —	1%
5	www.cfme.chiba-u.jp Internet	16 words —	1%
6	research.ijcaonline.org Internet	11 words —	1%
7	Yadav, R.B.. "Retrieval and classification of shape-based objects using Fourier, generic Fourier, and wavelet-Fourier descriptors technique: A comparative study", Optics and Lasers in Engineering, 200706 Crossref	10 words —	1%
8	oatao.univ-toulouse.fr Internet	10 words —	1%
9	tel.archives-ouvertes.fr Internet	9 words —	< 1%
10	www.sersc.org Internet	9 words —	< 1%
11	Lecture Notes in Computer Science, 2013. Crossref	8 words —	< 1%
12	Lecture Notes in Computer Science, 2015. Crossref	6 words —	< 1%

EXCLUDE QUOTES ON EXCLUDE MATCHES OFF
EXCLUDE BIBLIOGRAPHY ON

Source: http://www.ithenticate.com/

Prevent Plagiarism in Publication

The Editorial Board had used the ithenticate plagiarism [http://www.ithenticate.com] tool to check the originality and further affixed the similarity index which is 11% in this case *(See Annexure-I)*. Thus the reviewers and editors are of view to find it suitable to publish in this *Volume-10, Issue-1, January-March, 2018.*

Citation:
Tushar Jain, Meenu and H. K. Sardana
"Design of Computer Vision System for Objects Recognition in Automation Industries",
Global Journal of Enterprise Information System. Volume-10, Issue-1, January-March, 2018. (http://informaticsjournals.com/index.php/gjeis)
DOI: 10.18311/gjeis/2018/20660
Conflict of Interest:
Author of a Paper had no conflict neither financially nor academically.