Comparison and Analysis of Different Feature Extraction Methods versus Noisy Images

Aziz Makandar, PhD
Professor
Dept. of Computer Science
Karnataka State Akkamahadevi Women's University, Vijayapura

Kanchan Wangi
Research Scholar
Dept. of Computer Science
Karnataka State Akkamahadevi Women's University, Vijayapura

ABSTRACT
There are three most effective feature extraction for images they are Speeded Up Robust Feature (SURF), Scale Invariant Feature Transform (SIFT) and Histogram Oriented Gradient (HOG). This study is tended to compare the feature detection strategies for images which have several noises. The effectiveness of this strategies for area unit dignified by observing variety of exact similarity between real images and noisy images established from algorithm. For this work, noisy images are three type gaussian, speckle, salt and pepper.

General Terms
Digital image processing, Noisy images and Image retrieval

Keywords
Feature extraction, SIFT, SURF, HOG and Image matching

1. INTRODUCTION
In this digital era digital images are used for standard of living like medical imaging, topographical statistics schemes, digital TV and physical science [2]. Commonly, noise is present in image throughout image acquisition method. The noise is produced in an image because of defective devices, communication bugs, compression issues with acquisition method [10] [17]. Noise is having an effect on ultrasound images and tomography images separately. [9] [11] [12]. Similarly, while measuring the crucial part of original and noisy images have an image process application [7] [8]. The aim of this study is extracting different feature descriptor from images and search out consistent matching points among the original and noisy images.

The feature descriptor offers distinctive informational data of an image and this data is appropriate for image matching [6]. In general, options area unit extremely different and invariant to position and scale [15]. Options area unit matches one after another from each image and this feature matching predicted geometrician space [4].

There are various methods for feature detection reportable to image keypoint descriptors from matching images [14][3]. This research work proposed comparison of various feature extraction methods for the various noisy images. For this research work used CIFER 10 dataset which is subset of CIFER 100 dataset which is consisting of total 80 million tinny images of 32*32 pixel real world color images. For work we used CIFER 10 subset of dataset which is having 10 classes of images and each class consist of training and testing images from original datasets.

2. FEATURE EXTRACTION METHODS
2.1 Scale Invariant Feature Transformation (SIFT)
SIFT offers strong tool to work individual invariant of image options give robust matching completely different views of image [1]. It is proposed and projected by Lowe, and offers feature that invariants to affine distortion, radiance changes, transformation, rotation and 3 D viewpoint changes [5].

SIFT is used to scale and allocate by scale space in Difference of Gaussion (DoG) with function having various values of σ. The scale space differentiates by constant factor M as shown in following equation,

$$D(x,y) = \{[G(x,y,M) - G(x,y)]^* I(x,y)\} \qquad (1)$$

To identify local minima and maxima of D(x,y,σ) a pixel related to 3*3 neighborhoods shown in following fig.

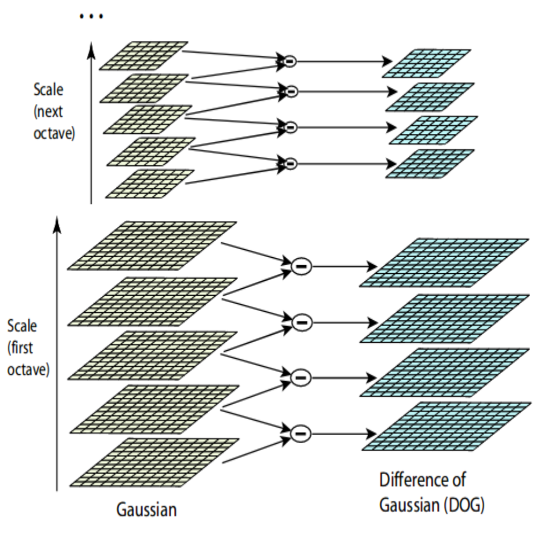

Fig. 1: Difference of Gaussian Pyramid

The idea is to detect the local maxima and minima for the images. It has divided into two steps:

i. Find local maxima and minima
ii. Remove key points selection

In next step, orientations are allocated on the bases of image gradient in key point location. Final step calculates local gradients of image around each key point and according key point orientation [1].

2.2 Speeded Up robust Features (SURF)

SURF is encouraged by SIFT, it used integral images based in the multiscale space proposition to creating the key points, and descriptors. As the integral images, SURF requires minimum number of operations for single box convolution and speed is increased [1].

Integral image is I(X) corresponds the sum of total pixel in the image is I with rectangular format.

$$I(X) = \sum_{i=0}^{x} \sum_{j=0}^{y} I(i,j) \quad (2)$$

The given image with point X=(x,y), Hessian matrix of H (x,σ) defined as:

$$\mathcal{H}(\mathbf{x}, \sigma) = \begin{bmatrix} L_{xx}(\mathbf{x}, \sigma) & L_{xy}(\mathbf{x}, \sigma) \\ L_{xy}(\mathbf{x}, \sigma) & L_{yy}(\mathbf{x}, \sigma) \end{bmatrix} \quad (3)$$

In direction to allocate location, the haar wavelet response are calculated in x and y directions which decrease both feature extraction and image matching time. At the end, SURF descriptor is extracted by creating square district related to selected direction.

2.3 Histogram Oriented Gradient (HOG):

In the year 2005 by NaveetDalal and Trigg, is proposed the HOG [1]. It is the descriptors are broadly utilized in computer vision with the determination of object recognition. The dominant HOG to describe the local object appearance and shape by distribution of neighborhood intensity gradients or edge. This technique is parallel to edge orientation histogram [3]. HOG was initially tested on the ImageNet-12 data set.

Firstly, pre-processed image and resized it in the 1: 2 ratio it is preferably 64*128 pixel. Then calculate the gradients of the images for each pixel in the image.

121	10	78	96	125
48	152	68	125	111
145	78	85	89	65
154	214	56	200	66
214	87	45	102	45

Fig. 2: Matrix format of image

The resultant gradients for change in x and y direction is as follows

$$\text{X direction } (G_x) = 89\text{-}78 = 11$$

$$\text{Y direction } (G_y) = 68\text{-}56 = 08$$

Calculate the magnitude and orientation of each pixel. Histogram generated the HOG feature descriptor for image.

3. EXPERIMENTAL RESULTS

The research work is focused on quantity effectiveness of different methods of feature detection such as SURF, SIFT and HOG on the noisy images. Assessment of noise invariance applied on the three noise types gaussian, salt and pepper, speckle noise on the deer images.

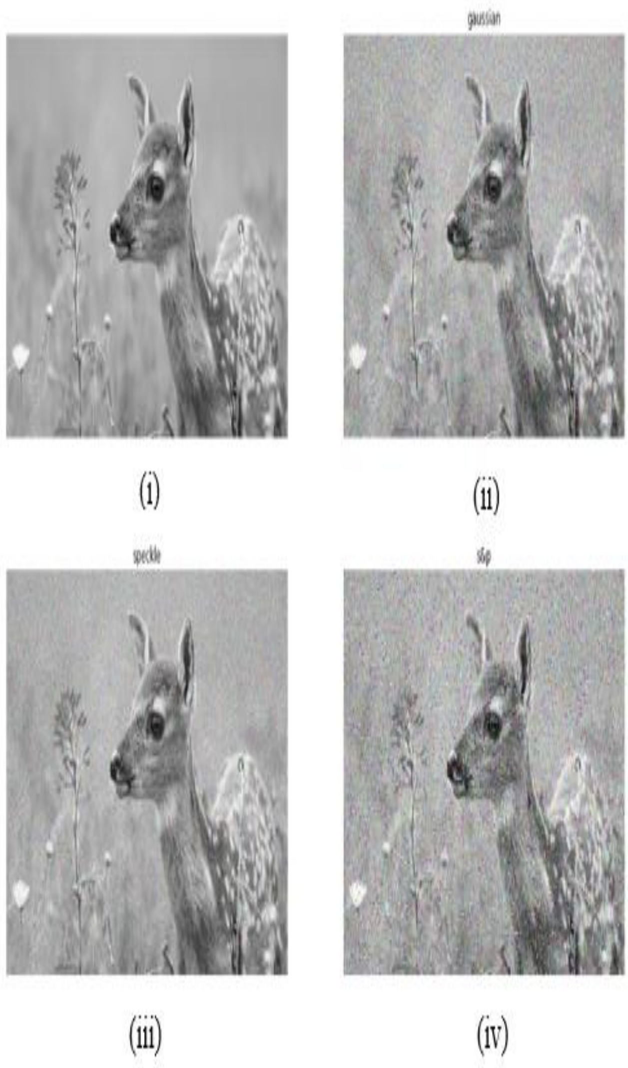

Fig. 3: Testing images (i) original deer image (ii) image with gussian noise (iii) image with speckle noise (iv) image with salt and pepper noise

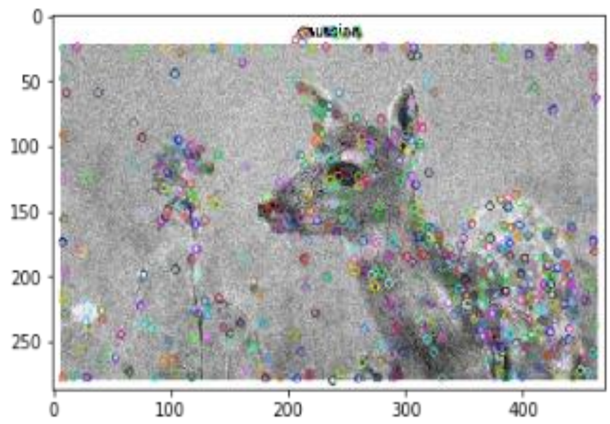

Fig. 4: Feature detected in noise image with gaussian using SIFT

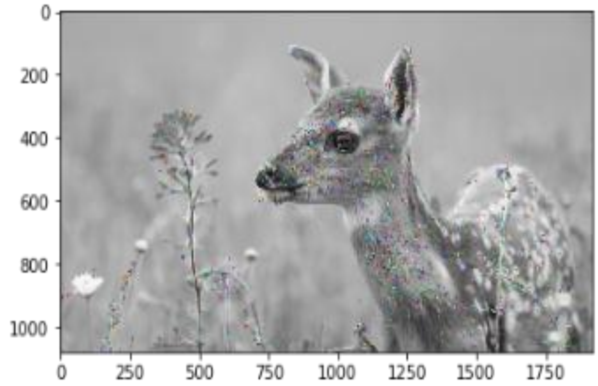

Fig.5: Feature detected in original deer image using SIFT

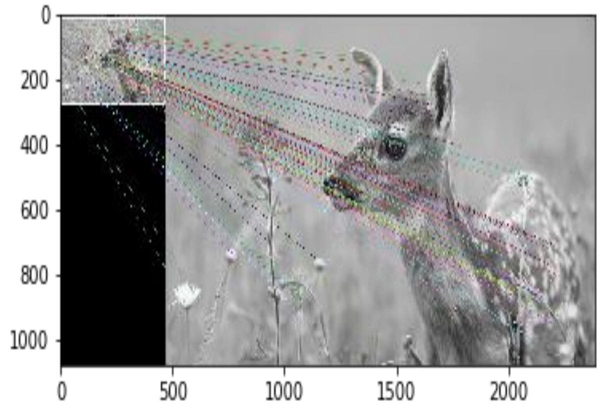

Fig.6: Best matching points between original and noisy image using SIFT

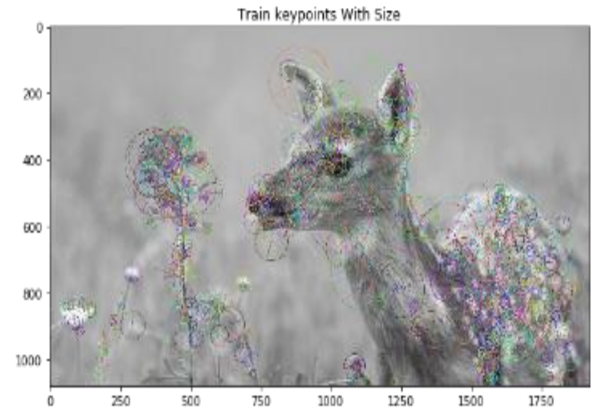

Fig. 7: Feature detected in noise image with gaussian using SURF

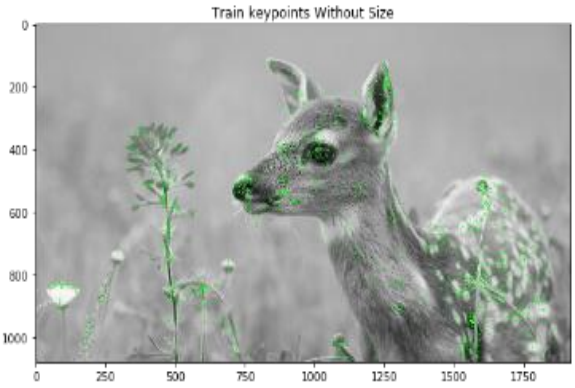

Fig.8:Feature detected in original deer image using SURF

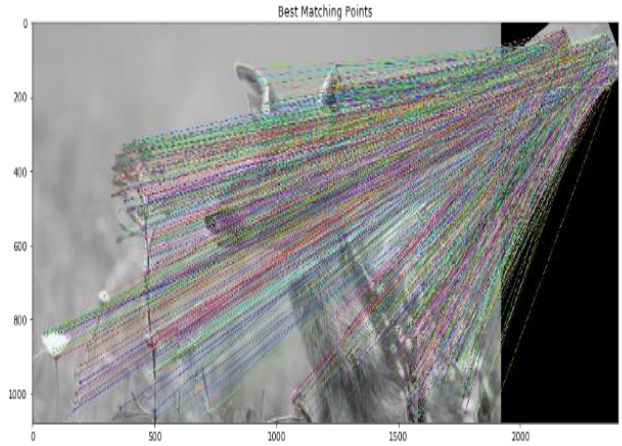

Fig. 9: Best matching points between original and Noisy images using SURF

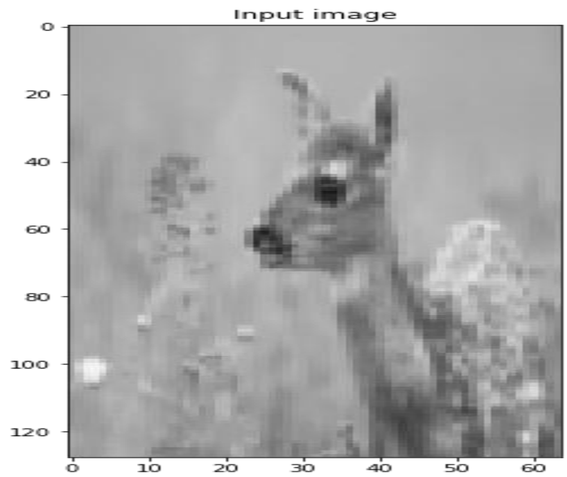

Fig. 10: Feature detected in original image using HOG

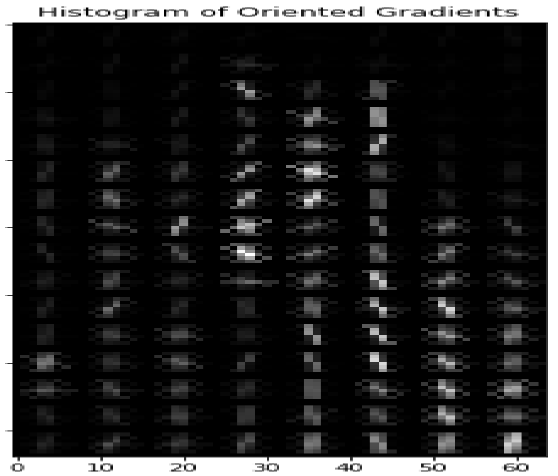

Fig. 11: Final feature descriptor of noise image using HOG

In this proposed work, gaussian noise are added ranging from 0.01 to 0.03, speckle noise added ranging from 0.04 to 0.06, finally salt & pepper noise with ranging from 0.05 to 0.07. features are detected from both original and noisy images using feature detection and descriptor methods. Identify and recognized the matching points between original and noise image and feature correspondences recorded.

Table 1. Effectiveness of images using sift algorithm

Noises	Noise Range	SIFT		
		Feature Detected Points	*Matching Detected Points*	*Effectiveness in %*
Gaussian	0.01	1537	237	16
	0.02	1432	176	11
	0.03	1402	138	10
Speckle	0.04	1562	262	17
	0.05	1621	223	14
	0.06	1532	198	13
Salt & Pepper	0.05	1833	267	12
	0.06	1840	215	13
	0.07	1936	176	09

Table 2. Effectiveness of images using surf algorithm

Noises	Noise Range	SURF		
		Feature Detected Points	*Feature Detected Points*	*Effectiveness in %*
Gaussian	0.01	1215	206	18
	0.02	1350	166	12
	0.03	1372	125	08
Speckle	0.04	1221	230	19
	0.05	1259	198	16
	0.06	1260	187	15
Salt & Pepper	0.05	1362	212	16
	0.06	1508	186	12
	0.07	1415	157	11

From table I and II, it is observed that SIFT detects more matching and feature points compare to SURF for all kinds of noises. In table II SURF algorithm is detected more robust feature which have sufficient information for image matching. While calculated effectiveness SIFT is less effective than SURF. Effectiveness is measure of matching feature with respect to detected Features.

4. CONCLUSION

This work is compared and analyzed various feature extraction methods on noisy images. It is identified and recognized the matching points between original image and noisy images. From experimental results, it is clear that the SIFT detected the more feature descriptor compare to SURF and HOG. The SIFT algorithm is randomly identifies and recognized key points from image steady but it is slow. The second feature detection method SURF is faster compared to other algorithm and it gives the better results in term of effectiveness of images. There is advantage of SURF is gives superior result compare to SIFT. HOG feature descriptor mainly concentrates on textual information of image. In future work it gives best results for feature detection, if it is applied for denoising of the images and retrieval for better quality of images.

5. REFERENCES

[1] A. Al Falou, "A comparative study of CFs, LBP, HOG, SIFT, SURF and BRIEF Techniques for Face Recognition", IOP Publishing, 2018, pp. 59-69.

[2] S. Nisha, A Nisha, and M sathik "A Study on Surf & Hog Descriptors for Alzheimer's Disease Detection", International Research Journal of Engineering and Technology (IRJET), vol. 4, no. 2, 2017, pp. 626-632.

[3] S. N. Raj, "Comparison Study of Algorithms Used for Feature Extraction in Facial Recognition," International Journal of Computer Science and Information Technologies (IJCSIT), vol. 8, no. 2, 2017, pp. 163-166.

[4] Aziz Makandar and Kanchan Wangi "Analysis and Techniques of Content Based Image Retrieval Using Deep Learning" Journal of Information and Computational Science, Vol.10, no.2, 2020, pp. 163-166.

[5] M Razali, N Mansho, A Halin, N Mustapha and R Yaakob "Analysis of SURF and SIFT Representations to Recognize Food Objects," Journal of Telecommunication Electronic and Computer Engineering, vol. 9, no. 2, 2018, pp. 81-88.

[6] N. Kaushik, R Rawat and A Bhalla, "A Brief Study of Different Feature Detector and Descriptor," International Journal of Advanced Research in Computer and Communication Engineering, vol. 5, no. 4, 2016.

[7] E Karami, S Parad and M Shehata "Image Matching Using SIFT, SURF, BRIEF and ORB: Performance Comparison for Distorted Images," In Proceedings of the 2015 Newfoundland Electrical and Computer Engineering Conference, Canada, 2017.

[8] Kanchan Wangi and A Makandar, "Content Based Image Retrieval Using Image Preprocessing Techniques," Strad Research, vol. 7, no. 12, 2020, pp. 413-419.

[9] S. Routray, A. K. Roy and C. Mishra "Analysis of various image feature extraction methods against noisy image: SIFT, SURF and HOG," in Second International Conference on Electrical, Computer and Communication Technologies (ICECCT), Coimbatore, 2017.

[10] H. Faraj and W. J. MacLean, "CCD noise removal in digital images," IEEE Transactions on Image Processing, vol. 15, no. 9, 2006, pp. 2676-2685.

[11] P. A. S. W. A. Pizurica, "A review of wavelet denoising in MRI and ultrasound brain imaging," Current Medical Image Rev., vol. 2, no. 2, 2006, pp. 247–260.

[12] S. Routray, A. K. Roy and C. Mishra "Improving Performance of KSVD Based Image Denoising Using Curvelet Transform," in IEEE. International Conference on Microwave, Optical and Communication Engineering, 2015.

[13] K. Mikolajzyk. and C. Schmid, "A Perforance Evaluation of Local Descriptors," IEEE Trans. Pattern Analysis and Machine Intelligence, vol. 27, no. 10, 2005, pp. 1615-1630.

[14] T. Linderberg, "Feature Detection with automatic scale selection," International journal of Computer Vision, vol. 30, 1998, pp. 79-116.

[15] H. Stokman and T. Gevers, "Selection and Fusion of Color Models for Image Feature Detection," EEE Transactions on Pattern Analysis and Machine Intelligence, vol. 29, no. 3, 2007, pp. 371 – 381.

[16] T. Kadir and M. Bardy, "Scale, Saliency and image description," International journal of Computer Vision, vol. 45, 2001, pp. 83-105.

[17] Aziz Makandar and K Karibasappa, "Wavelet based medical image compression using SPHIT", Journal of Computer Science and Mathamatical Science 1, 2010, pp. 769-775.