International Journal of Advance Research in Science and Engineering
Vol. No.4, Issue 11, November 2015
www.ijarse.com
IJARSE
ISSN 2319 - 8354

FUSION OF SCALE INVARIANT FEATURES TRANSFORM AND WAVELET TRANSFORM TECHNIQUES FOR OBJECT DETECTION

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ABSTRACT

Detecting the salient regions on feature points in an image is very fundamental and important task to digital image processing. There are numbers of techniques present now days for recognizing the objects in an image. The paradigm that is followed in this paper is to detect the object based on features. The feature based techniques include SIFT, SURF, FAST, MSER and so on. This paper presents only one method for scale and rotation invariant features descriptors that is SIFT based on transformation techniques DWT. A Haar wavelet type of wavelet transform is used in the research and these are the forms that are used in many methods of discrete wavelet transform and processing. Decomposing an image to low and high resolution is the basic idea of transformation. corner detection technique is applied to low resolution image and SIFT is applied to high resolution image further matching of features is done over them which is further followed by estimating geometric transformation and object detection will be done. SIFT descriptor of fused DWT are computed to form final features match and detect the particular region or object in image.

Keywords: Corner Detection, Digital Image Processing, Discrete Wavelet Transform, Geometry Estimation, Scale Invariant Feature Transform.

I. INTRODUCTION

1.1 Introduction to Digital Image Processing (DIP)

Detecting the desired region/object in an image is a long-lasting research topic in an image processing system. In our everyday life we come across various objects and we recognize, detect them with little efforts. Despite the fact that the objects may vary in color, shape, texture etc. We have senses and thus we can easily classify and distinguish the objects. But if we want that a computer has to perform this task, which does not have any sort of sense and intelligence. For this we have to indulge the intelligence to the system and that is considered as artificial intelligence which we can attain with the help of training or programs [1]. Image Processing now a days is used in almost every area. Especially, it is finding its use in an application area such as the quality based studies, generalizes its use with its structure that meets the needs of the people.

Digital Images are electronic snapshots taken of a scene or scanned from documents, such as photographs, manuscripts, printed texts, and artwork. The digital image is sampled and mapped as a grid of dots or picture elements (pixels). Each pixel is assigned a value (black, white, shades of gray or color), which is represented in binary code (zero's and one's).Technically DIP is an act of bringing out the data i.e. obtained in the wake of the

identification and detecting of the image that the digital environment carries out. [2] It is the process of modification done upon images or the sequence of images in digital environment. Most of the IP techniques treat the images as a 2D signal and then applying standard techniques to it. DIP involves a number of fundamental steps such as: image acquisition, image enhancement and preprocessing, edge detection and segmentation, representation, description, matching and detection. The output of these steps is either an image itself or an attribute of an image [3].

1.2 Object Detection:

Object detection, tracking, and recognition in images are very key problem in computer vision. Object detection is a technique or method for identifying the objects in an image or it can be simply defines as the task of finding and identifying the objects in the real world from an image of the world with the help of object models which are known priory [4]. But if we talk about the computer vision it can be termed as the task to perform. Humans can recognize the objects effortlessly without being aware of the changes in an object's appearance due to number of factors such as view point variation, shadow, illumination etc. To detect an object from digital image is major task in image processing. It is a hot research issue to detect and classify the features based on IP technology.

The detection process in the image is carried out by the process of extracting the key points from an image which is very important and valuable. These key points have many applications in image processing like the detection of objects in an image, registration of an image, tracking of an object [5]. Object and shape recognition etc. by simply extracting the key points, we can use them for find the particular objects in number of images. If the points matched in the images they can simply be categorized as the detected object in an image. Object detection mainly consists of two steps:

1.2.1 Object Detection Approaches: Generally there are three methods available for detecting the object, they are:

1. Geometry Based Approach
2. Appearance Based Approach
3. Feature Based Approach

Feature Based method: - A search is used to find feasible matches between object features and image features. The primary constraint is that a single position of the object must account for all of the feasible matches. This technique first computes the entire responses of features that are detected in the scene and collects them into a feature vector.

Feature based approach is concerned with the detection of the object based on the features of the object. The central idea behind the feature object detection algorithms lies in identifying the key points, often occurred at intensity discontinuity that are invariant to change due to scale and illumination. Methods that extract features from the objects to be detected and the images to be searched.

- surface patches
- corners detection
- linear edges

Based on the features there are two main classes, i.e., local and global approaches [8] [9]. A local feature is a property of an image (object) located on a single point or small region. It is a single piece of information describing a rather simple, but ideally distinctive property of the object's projection to the camera (image of the object). Examples for local features of an object are, e.g., the color, (mean) gradient or (mean) gray value of a pixel or small region. For object detection tasks the local feature should be invariant to illumination changes, noise, scale changes and changes in viewing direction, but, in general, this cannot be reached due to the simpleness of the features itself. Global features try to cover the information content of the whole image or patch, i.e., all pixels is regarded.

1.3 Scale–Invariant Feature Transform (SIFT)

SIFT, currently best known feature descriptor, solve many real world applications in object recognition and detection. SIFT is a descriptor that was proposed by Lowe, is one of the most widely used feature detection algorithm. Objects can be indexed and detected with the help of histograms of key points in images. **Scale-invariant feature transform** is an algorithm in computer vision to detect and describe local features in image .object recognition, detection, robotic mapping and navigation, 3D modeling, gesture recognition is its applications. The SIFT (scale invariant feature transform) is one of the most widely used feature representation scheme for vision application. The SIFT approach is able to extract feature that are intensive to certain scale and illumination changes. SIFT based methods are expected to perform better for objects with rich texture information as sufficient numbers of point can be extracted. On the other hand they also require sophisticated indexing and matching algorithm for effective object detection [6].

1.3.1 SIFT Algorithm overview

1.3.1.1 Feature Descriptors: It is a sort of method for representing the visual information for detection is to store descriptions of objects that only consists the features that are visible from a particular view point. An object can be concluded as the detected one, if the feature description i.e. derived from an image of the object matches well to the feature descriptor i.e. stored in the memory.

1.3.1.2 Feature detection: Detection is followed by feature description. To represent any region, which are detected point, a large number of different method have been developed. It is also refers to the interest point detection or the key points detection for finding the image which are some how special. Typically it means that these points correspond to some elements of the scene that can be reliably located in different views of that scene .That means Feature detection = how to represents the intensity points or features in an image.

1.3.1.3 Feature matching: Image matching refers to finding a correspondence between the data sets. In the application of computer vision and image processing, the concept of feature detection refers to the methods that aim at computing abstractions of image information and making local decisions at every image point whether there is an image feature of a given type at that point or not. The resulting features are considered as the subsets of the image domain .

1.4 Corner Detection- Corner Detection is an approach within computer vision to extract certain Kinds of features and after infer the contents of an image. Corner Detection is frequently used in motion detection, image matching, video tracking, 3D modeling, and object detection. Corner detection can be defined as intersection between two

edges. A corner can also be defined as a point for which there is two dominant and different edges direction in local neighborhood of the point. Many applications require relating two or more images in order to extract information from them. The brute force method of comparing every pixel in the two images is computationally prohibitive for the majority of applications .Intuitively, one can image relating two images by matching only locations in the image that are in some way interesting. Such points are referred to as interest points and are located using an interest point detector. Finding a relationship between images is then performed using only these points. This drastically reduces the required computation time. Many different interest point detectors have been proposed with a wide range of definitions for what points in an image are interesting **[**7**]**.

1.5 Discrete Wavelet Transform

A DWT is any wavelet transform for which the wavelets are discretely sampled. In case of images, image has been decomposed on wavelet decomposition techniques using transform with different levels of decomposition. Decomposition mainly performs on two different images . Wavelet consists of many types like Haar, Morlet, Daubechies etc. Haar is the first DWT, was invented by Hungarian mathematical Aefred Haar. For an input represented by list of 2n numbers, the Haar wavelet transform may be considered to pair up input values, storing the difference and passing the sum. The discrete wavelet transform, a generalization of Fourier analysis, is widely used in several signal and image processing applications **[**7**]** [8].

1.5.1 Haar Wavelet: Nowadays, several definitions of the Haar functions and various Generalizations as well as some modifications were published and used Wavelet transforms have advantages over other traditional transforms because local features can be described better with wavelets. Wavelet analysis consists of decomposing a signal or an image into a hierarchical set of approximations and details. For images analysis we used two-dimensional wavelets and corresponding scaling functions obtained from one dimensional wavelets by tensorial product. Haar and wavelet transform provides a multi resolution representation of an image with wavelet features at different scale capturing different levels of details [9].

II. LITERATURE SURVEY

D. Kaur et al. The texture of skin images is studied and various processes has been applied to observe the skin color in images. They shifted the skin texture analysis towards the gray level profile analysis which helps providing the idea about the skin sensitivity. They explained the work as skin gray color profile has been taken as the input parameter in order to ascertain the skin profile.

R. Yogamangalam et al. Presents a brief outline on some of the most common segmentation techniques like thresholding, Model based, Edge detection, Clustering etc., mentioning its advantages as well as the drawbacks. Some of the techniques are suitable for noisy images. In that Markov Random Field (MRF) is the strongest method of noise cancellation in images whereas thresholding is the simplest technique for segmentation.

III. RESEARCH METHODOLOGY

3.1 Problem Formulation - As the research work is related to the object detection, number of objects will be there for detection depending on number of factors. The work has been considered in this research, is the

technique followed for detecting the objects in cluttered images with the help of detecting the features. The feature based algorithms SIFT using Wavelet transformation is considered for detecting the features. Earlier, numbers of algorithms were there for detecting the objects in an image, such as SURF, SIFT, FAST, MSER etc. In this research, the fusion of two techniques is done for having the appropriate results. The Haar wavelet technique is used for decomposition of image and applying SIFT, a features based algorithm for detecting the object in a cluttered images. SIFT is applied on high resolution decomposed image and corner detection in applied on low resolution image. The parameter considered for fusion is the time taken by both of the algorithms and the region detected by both of them. Analysis and performance table will show the time and accuracy for detecting the region and will detect the exact region which has to be expected. As the work is related to the detection of object using feature based approach applying wavelet transformation (Haar Wavelet), the cluttered images are considered for implementing purpose. Image processing techniques are also applied for performing the tasks over the images. Such sort of problems can be solved with the help of image processing techniques and appropriate algorithm.

3.2 Research Methodology The methodological steps adopted in the study are:

Stage 1 Sample Design

Sample unit: cluttered images, images which consist of large number of objects/ images.

Sample size: set of images of cluttered image for objective. For the purpose of checking the correctness of the algorithms with DWT technique numbers of the different images are considered for detecting the feature based objects in an image.

Stage 2 Approaches of Data Collection

Secondary Data: Collected from reports, books, magazines, internet, journals and organizations. Data Collection: Secondary data is collected for the purpose of study. As in case of clutter Image, it is quite difficult to collect information by own. Thus, the data is collected from various journals, organizations, and other sources. On the basis of data gathered the functions and operations are applied for detecting the objects.

Stage 3 Research Type:

Quantitative Research: The results of objective are a quantitative. Quantitative research focuses in counting and classifying features and constructing statistical models and figures to explain what is observed. The description in such research is focused and it is a conclusive type of research.

Qualitative Research: The objective is actually also related to the Qualitative Research. Qualitative research is concerned with the personal information and deeper responses. It is an exploratory type of research. As the study is related to the object detection it will only provide the quality measurement of the data

3.3 Flowchart for working Algorithms: - As the very first step is the acquisition of an image, here we are considering the set of cluttered images. For using this methodology in the thesis work, first the Actual image is required where the object has to be detected. Further, the query image is required i.e. the image/object which has to be detect in the Actual image. After that, transformation technique DWT is applied on images which will decompose the images into low-frequency sub-band and high frequency sub-band using wavelet transformation. Next step is to detect the features with the help of feature detection algorithms. In this thesis work the fusion of

two algorithms are considered to detect the region that are SIFT and corner detection. Feature detection is used to detect the interest points or key points in the image.

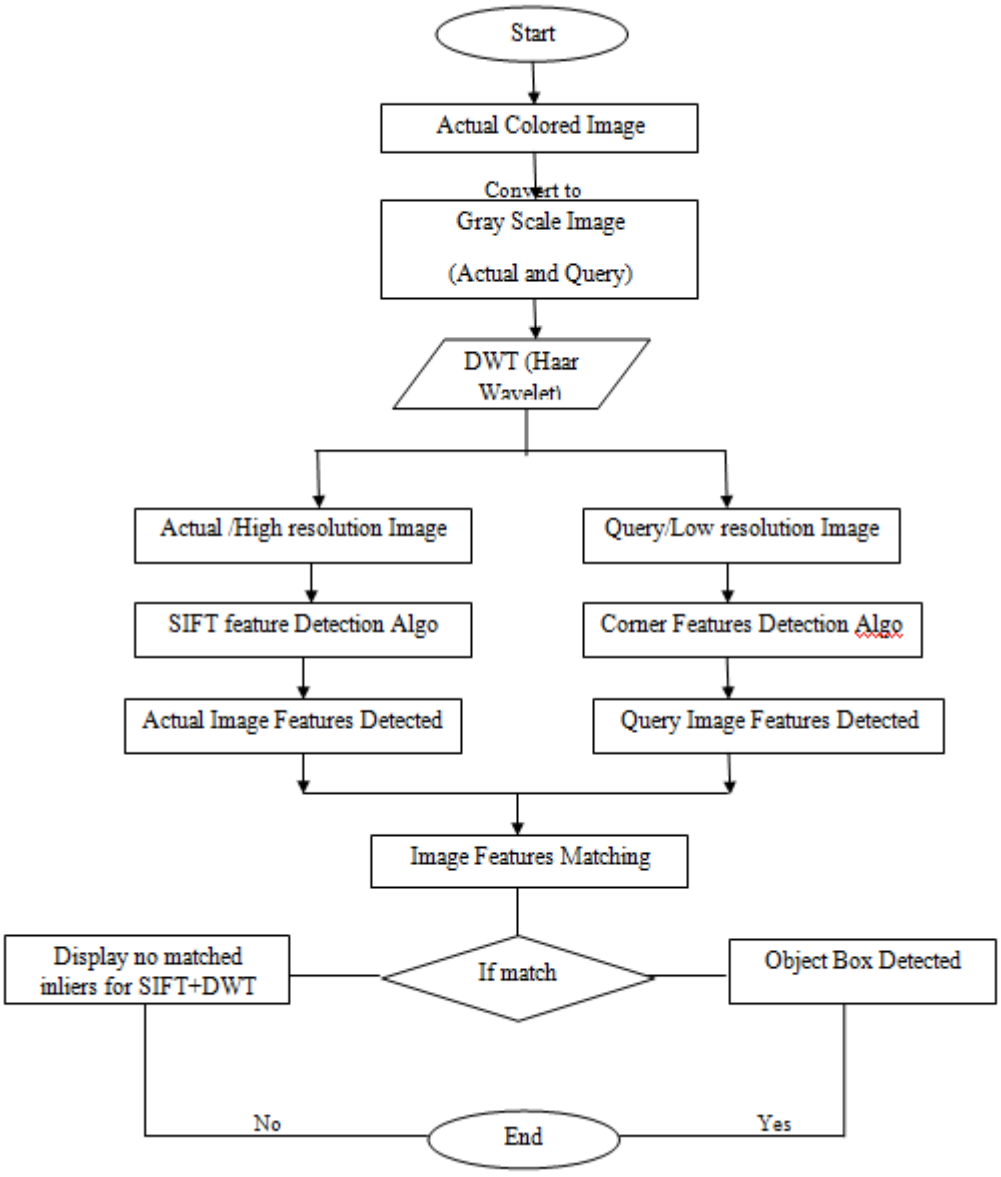

Fig.3.1: Flowchart for features based object Detection using DWT technique

Typically it means that these points correspond to some elements of the scene that can be reliably located in different views of that scene. Now the extracted features will be matched of both of the images.Generally matching the points the query image is transformed and further the location of the object is estimated over the actual image. At last if the object is detected it will be shown and if no inliers are matched with actual image then no region is detected between two images.

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www.ijarse.com
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IV. IMPLEMENTATION

Load Image (Actual Cluttered Image):-

Fig. 4.1: Actual Colored Image

Fig. 4.2: Query Colored Image

Gray Scale Conversion and Pre-processing Operation -In next Step Gray scale conversion and Pre-processing operations like brightness, Histograms of Actual and Query grayscale Images to remove unwanted noise etc.

Fig. 4.3: Actual Grayscale Image

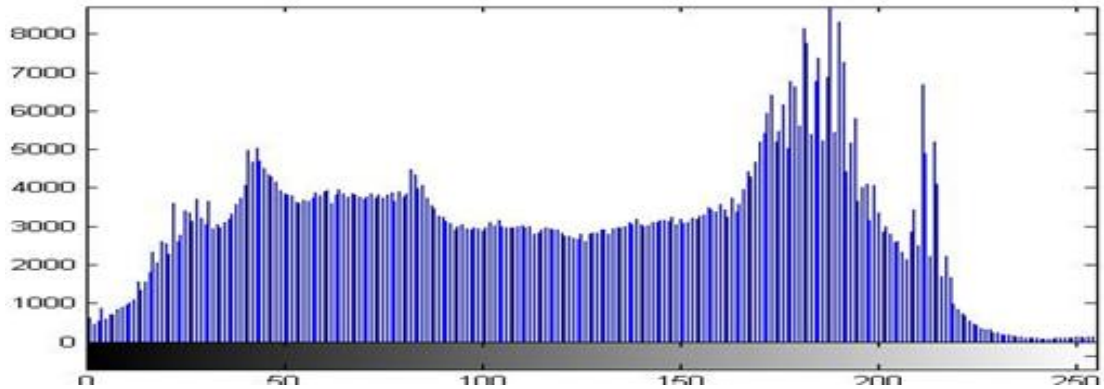

Fig. 4.3: Pre-processing Operation (Histogram of Actual Grayscale Image)

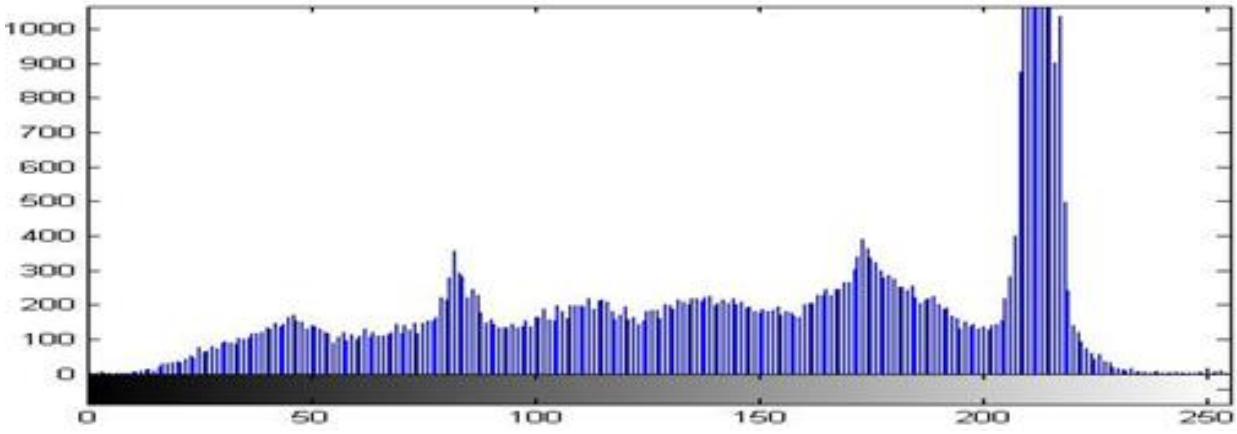

Fig.4.4: Histogram of Query Grayscale Image

Discrete Wavelet Transform(Haar Wavelet)- In next step, DWT(Haar Wavelet), a decomposition technique is used to decompose an image into low(Query) and High(Actual) resolution images

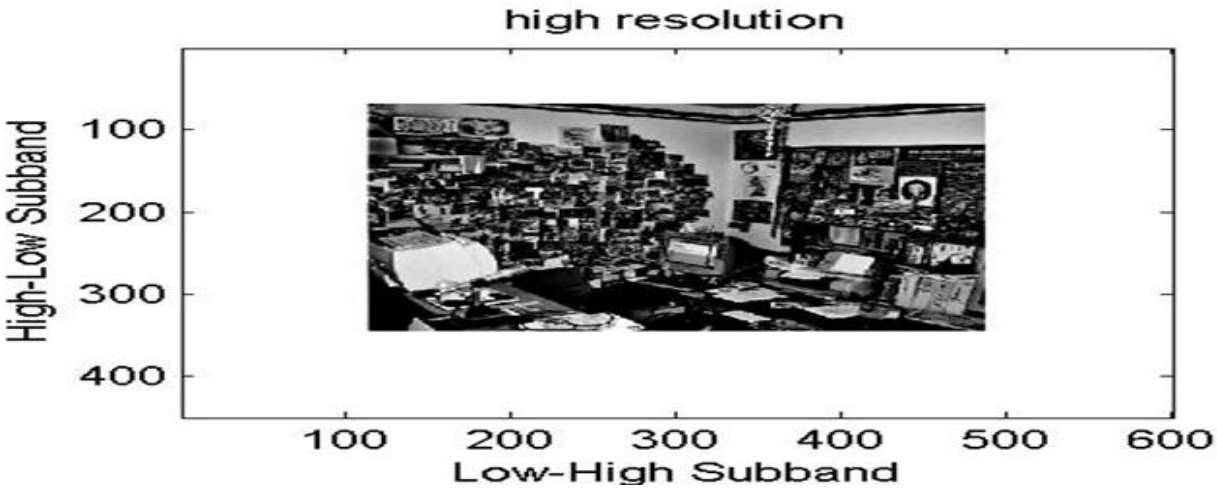

Fig.4.5: Low Resolution Image

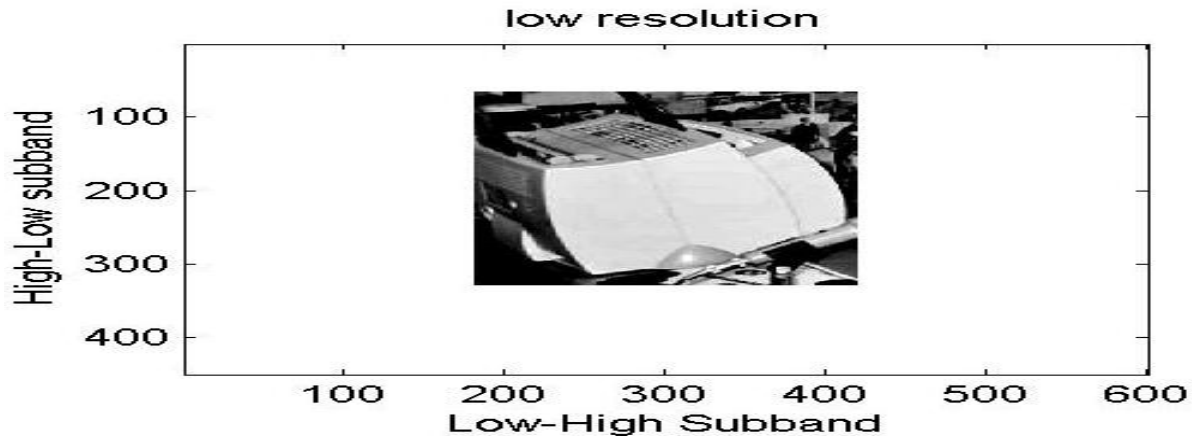

Fig.4.6: High Resolution Image

Features Detection Using SIFT- In next step, features Detection on Actual and Query image using SIFT, a features based algorithm

Fig.4.7: Features Detection using SIFT on Actual Image

Features Detection Using Corner Detection-

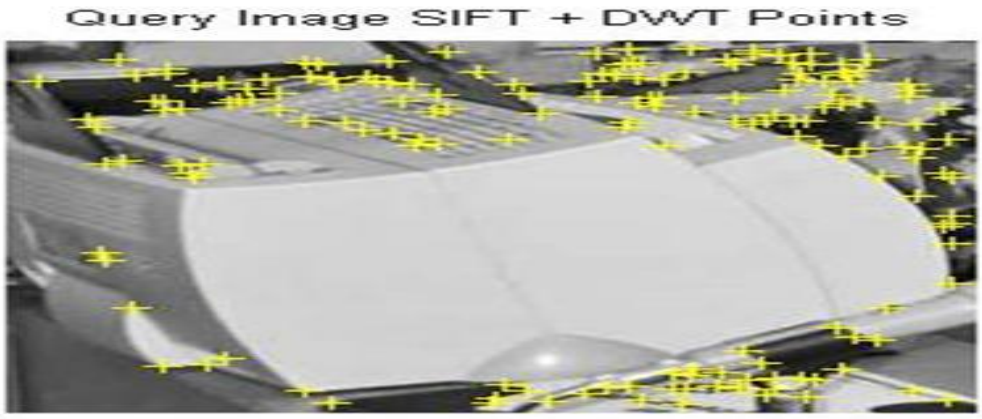

Fig.4.8: Features Detection using Corner detection algorithm on Query Image

Features Matching-

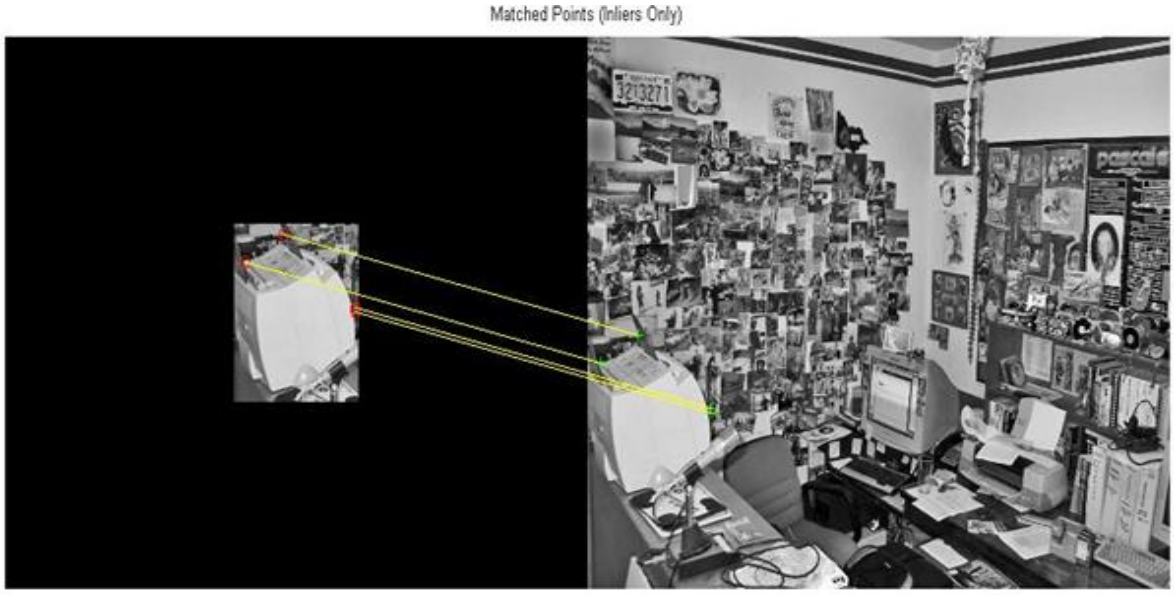

Fig.4.9: Features Matching between Actual and Query Image

Region Detection-

Fig.4.10: Detected region between Actual and Query Image

Similarly, same steps are followed for ten set of cluttered images, in some case when it does not match inliers for actual Query image then region detected as shown in figure 4.11.

Fig.4.11: No matched inliers

4.12 Analysis Table

Algorithm (SIFT+DWT)	Dimensions for Actual Images	Dimensions for Query Images	detected points in Actual Images	detected points in Query Images	matched points in both images	Detected object/region	Time taken in seconds
Image Set 1	(757X1024)	(243X219)	4301	200	4	Very Clear	17.9888s
Image Set 2	(757X1024)	(190X210)	4301	200	3	Very Clear	17.5941s
Image Set 3	(757X1024)	(263X435)	4301	200	No Matched inliers for SIFT+DWT (0)	Not Detected	13.5949s
Image Set 4	(757X1024)	(198X264)	4301	155	3	Clear	13.0859s
Image Set 5	(338X450)	(133X156)	579	66	3	Very Clear	2.2255s
Image Set 6	(550X420)	(108X112)	710	83	3	Clear	3.2390s
Image Set 7	(525X700)	(182X187)	1984	71	3	Clear	6.1423s
Image Set 8	(525X700)	(222X123)	1984	120	4	Very Clear	6.1608s
Image Set 9	(466X700)	(167X111)	2186	114	5	Very Clear	5.5620s
Image Set 10	(338X450)	(59X129)	776	79	4	Clear	2.3284s

V. CONCLUSION AND FUTURE SCOPE

As the study undergoes the observational study the work has been conducted on the dataset that has been selected with the help of simple random sampling. When we capture the image, there are some facts involve in objects present in the image. Here the objects can be detected on the basis of features, whether they are decomposed using Haar Wavelet and apply SIFT features detection and corner detection algorithm for features detection, matching, geometric transformation for detecting inliers and region detection. As the work is related to feature based object detection, further facts can be there in cluttered image applications by fusing scale invariant features transform and Haar wavelet Transform. From the result obtained, it is gathered that under similar conditions, SIFT has optimal performance in regard to its predecessors. SIFT can be used to discover

analogous objects in two different images. The SIFT algorithm is evidently competent to detect whether the query object exists in actual image or not. Finally, determine how much efficient the fusion of SIFT and Corner detection with transformation technique DWT, also time taken by different images for detection of objects.

The SIFT and Corner features algorithm improves on previous approaches by being largely invariant to change in scale, illumination, partial occlusion in cluttered images. A final stage that detect object using SIFT and Corner detection is used for accuracy determination.

REFERENCES

[1] R.Yogamangalam et al. "Segmentation Techniques Comparison in Image Processing "International Journal of Engineering and Technology (IJET), Vol. 5, No 1, pp.-307-313, Feb-Mar 2013.

[2] Md.Amran Hossen Bhuiyan et al. "Image Processing for Skin Cancer Features Extraction", International Journal of Scientific & Engineering Research, Volume 4, Issue 2, pp. 1-6, February-2013.

[3] Ms. Shubhada. K. Nagralei et al. "Application of Image Processing for Development of Automated Inspection System", International Journal of Computational Engineering Research (ijceronline.com) Vol. 3 Issue. 3, 2013.

[4] Devis Tuia et al. "recent advances in remote sensing image processing" IEEE, Conference: 7-10 Nov. 2009.

[5] B.B. Chaudhuri et al. "Target Detection: Remote Sensing Techniques for Defense Applications", Defence Science Journal, Vol 45, No.4, October 1995, DESIDOC.

[6] Juergen Gall et al."Class-Specific Hough Forests for Object Detection",Decision Forests for Computer Vision and Medical Image Analysis Advances in Computer Vision and Pattern Recognition,CVPR'09 conference, 2013, pp 143-157; Springer.

[7] Ireyuwa. E. Igbinosa, " Comparison of Edge Detection Technique in Image Processing Techniques", International Journal of Information Technology and Electrical Engineering, Volume 2, Issue 1, pp. 25-29, February 2013.

[8] Amiraj Dhawan et al."Implementation of Hand Detection based Techniques for Human Computer Interaction"International Journal of Computer Applications IJCA Journal, Volume 72 - Number 17, pp. 6-13, 2013.

[9] Ms. Shweta Tyagi, Mr. Hemant Amhia., Mr. Shivdutt Tyagi, "Comparative Study of Image Enhancement and Analysis of Thermal Images Using Image Processing and Wavelet Techniques", International Journal of Computational Engineering Research, Vol. 03, Issue 4, pp. 32-38, April 2013.