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FUSION OF SCALEINVARIANT FEATURE TRANSFORM AND WAVELET TRANSFORM TECHNIQUES FOR OBJECT DETECTION

Anjana Kumari[1], Mr. Ravinder Thakur[2]

[1,2]CSE Department, L.R.I.E.T Solan, (India)

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. One of most popular techniques include is feature based method. The paradigm that is followed in the dissertation is to detect the object based on features. The feature based techniques include SIFT, SURF, FAST, MSER and so on. This study 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.

The image transform theory is well known area characterized by a precise mathematical background. In 2-D both the Haar and Wavelets function products may be treated as extractors of particular image features and for features extraction , DWT of image are first computed and linear and linear combination of all the obtained sub bands are taken. 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. Fusion of two techniques has been done in the research work those are SIFT and DWT.

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

I. INTRODUCTION

1.1 Digital Image Processing

Before understanding the concept of Digital Image Processing we must have an idea of what actual digital image is? DIGITAL IMAGES are electronic snapshots taken of a scene or scanned from documents, such as photographs, manuscripts, printed texts, and artwork. [7]

Fig.1.1 Digitizing the Signal

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). The binary digits ("bits") for each pixel are stored in a sequence by a computer and often reduced to a mathematical representation. [6]

1.2 Pixel Representation

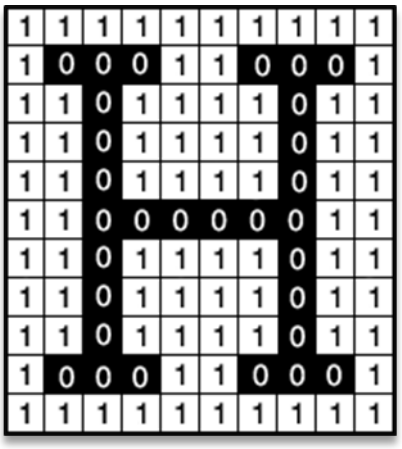

Fig1.2 Pixel Representation

Black Pixel = represented by 0

White Pixel = represented by 1

1.3 Object Detection

In general, object detection means where the object in an image is.

Input- A clear image of an object or some kind of model of an object possibly containing object of interest.

Output- position, or a bounding box of the input if it exists in the image.

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. 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.[8] To detect a 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.

1.4 Object Detection Approaches

Generally there are two methods available for detecting the object, they are:

a. Appearance Based Approach.

b. Feature Based Approach.

1.4.1 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 recognition algorithms lies in identifying the key points, often occurred at intensity discontinuity that are invariant to change due to scale and illumination.[2]

1.4.2 Scale–Invariant Feature Transform (SIFT)- 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. [8]

- Key points of objects are first extracted from a set of reference images and stored in a database.
- An object is recognized in a new image by individually comparing each feature from the new image to this database and finding candidate matching features based on Euclidean distance of their feature vectors.

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 no. of point can be extracted.[1]

1.4.3 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.[4] 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.

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.[1]

Haar Wavelet- Haar functions are used since 1910. They were introduced by Hungarian mathematician Alfred Haar .Nowadays, several definitions of the Haar functions and various generalizations as well as some modifications were published and used. One of the best modification, which was introduced, is the lifting scheme These transforms have been applied, for instance, to spectral techniques for multiple–valued logic, image coding, edge extraction, etc [7]. Over the past few years, a variety of powerful and sophisticated wavelet based schemes for image compression. Wavelet scheme gives many advantages, which are used in the JPEG–

2000 standard as wavelet–based compression algorithms. The Discrete Wavelet Transform uses the Haar functions in image coding, edge extraction and binary logic design and is one of the most promising techniques today. The non–sinusoidal Haar transform is the complete unitary transform [3].It is local, thus can be used for data compression of non–stationary "spiky" signals. The digital images may be treated as such "spiky" signals.

II. LITERATURE REVIEW

An improved algorithm of multi-source remote sensing image registration based on SIFT and Wavelet Transform Chao Ding, Yali Qin, Linchang Wu This paper proposes an improved algorithm based on SIFT and Wavelet Transform. By using Wavelet Transform, First the image will be decomposed into low-frequency sub-band and high-frequency sub-band .Then SIFT feature points are extracted of the low-frequency and the image's edge feature points of the high-frequency by curvature scale space(CSS) corner detection. Finally they choose the fine matching points to realize the image registration using the improved random sample consensus (RANSAC).

Digital Image Processing *Minakshi* Kumar This paper describes the basic technological aspects of Digital Image Processing with special reference to satellite image processing. Image Rectification and Restoration is done by initial processing of raw image data to correct for geometric distortion, to calibrate the data radio metrically and to eliminate noise present in the data. Further enhancement techniques are applied. This paper generally presents the basics of digital image processing.

Comparison of Edge Detection Technique in Image Processing Ireyuwa. E. Igbinosa

This paper shows the comparison of edge detection techniques under different conditions showing advantages and disadvantages of the selected algorithms. This was done under Mat lab. The discontinuities are abrupt changes in pixel intensity scene.

III. PROPOSED SYSTEM

In the proposed system I have done the work in feature based algorithm that is SIFT and Haar Wavelet transform for decomposition and for discrete image 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. Fusion of two techniques has been done in the research work those are SIFT and DWT. The main objective of the proposed system is to identify the best suitable feature based and fuse DWT technique with this algorithm especially in the cluttered image application**.**

3.1 Research Methdology

The methodological steps adopted in the study are

Stage 1) Sample Design

Sample unit Cluttered Image

Sampling Type Simple random sampling.

The data will be selected random sampling basis.. Number of images will be selected for study purpose. The purpose of selecting cluttered images is to check out the accuracy after the implementation of the algorithm.

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 remote sensing, it is quite difficult to collect information by own. Thus, the data is collected from various journals, organizations, and other sources.

Stage 3) Design and Method:

Observational Method

Number of different objects in one image that is cluttered image is considered and algorithms are applied on them for the purpose of object detection. First objective will be carried out by applying feature based algorithm. DWT technique is used to decompose the image and using SIFT feature detection method to, extraction, matching and to detect the object.

Stage 4) Research Type

Quantitative Research The results of first 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 Qualitative research is concerned with the personal information and deeper responses. As the study is related to the object detection it will only provide the quality measurement of the data. Qualitative research aims to gather a more inclusive understanding to a particular behavior and the reason why such behavior exits such as to compute the time, accuracy etc.

3.2 Preprocessing operation using Digital Image Processing on Cluttered Image

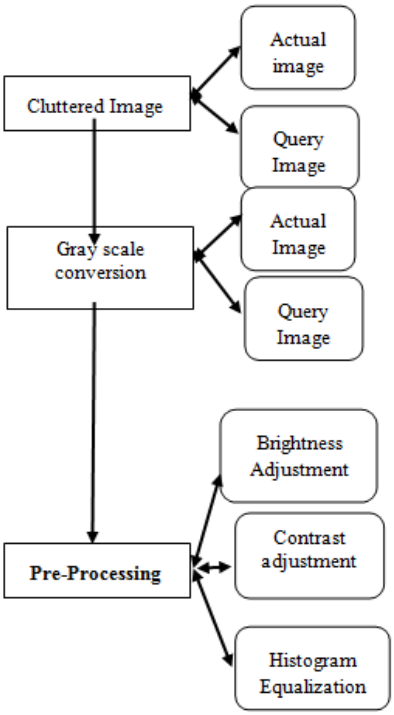

Fig.3.2 Preprocessing on cluttered Image

I Step The image is to load which consists two of the images, scene image and query image.

II Step If the images are colored images of any of the color space model such as RGB, HSV etc. they have to convert to the gray scale image because the tool here am using is MatLab R2013b version which do not support any sort of operation or manipulation over them. Such sort of manipulation can be done over the 8 bit images which consist 0-255 shades of gray. **In last step**, For example, we can remove noise, sharpen or brighten an image, making it easier to identify key features. It generally consists of two techniques Post and Preprocessing. But for the thesis work the data collected is secondary data and assumed that the post processing is already has been done and then provided the data. Pre-processing considered here in the thesis work includes adjusting image brightness, contrast and then equality the histogram.

3.3 Object Detection using DWT

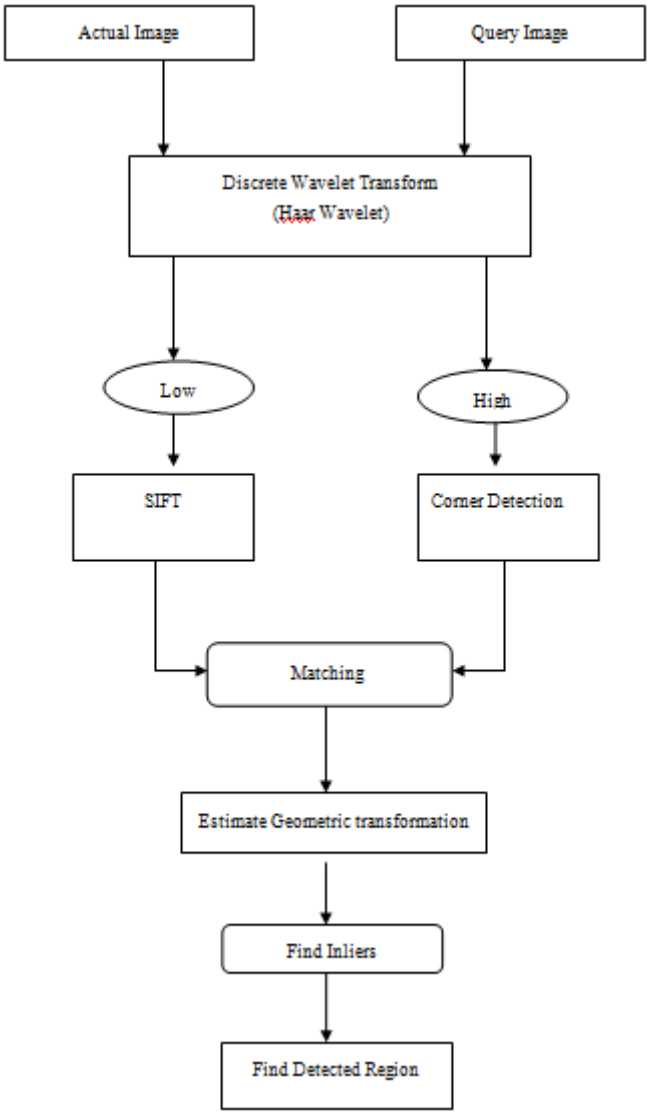

Fig.3.3 Architecture of Object Detection Using DWT Technique Applying SIFT

IV. IMPLEMENTATION

4.1 Feature Descriptors

It is a sort of method for representing the visual information for recognizing 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 recognized 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. But the point is to keep in mind is that the feature descriptions encode only some of the features present in an image.

Ideally features of an object can be extracted from images, depending on the view point variation, illumination and many more. But this may suffer the recognition performance e.g. if the features of an object from an image are extracted from any view and the object then it might be necessary to store more than one feature description of the object to recognize it from these different viewpoints.

4.2 Feature Detection

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.

Feature detection = how to represents the intensity points or features in an image .

Feature Extraction: It refers for computing a descriptor from the pixels around each interest points. The simplest descriptor is just the raw pixel values in small region around the interest point.

4.3 Feature Extraction

how to represents the intensity points to compare them with other interesting points or we can say features in an image.

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.

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Figure 4.1 Actual/Cluttered Image

Figure 4.2 Query Image

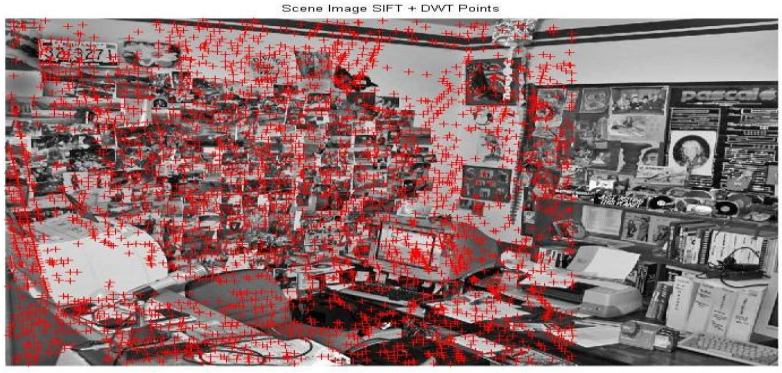

Fig.4.3 Actual Image SIFT+DWT

Fig. 4.4 Query Image SIFT+DWT

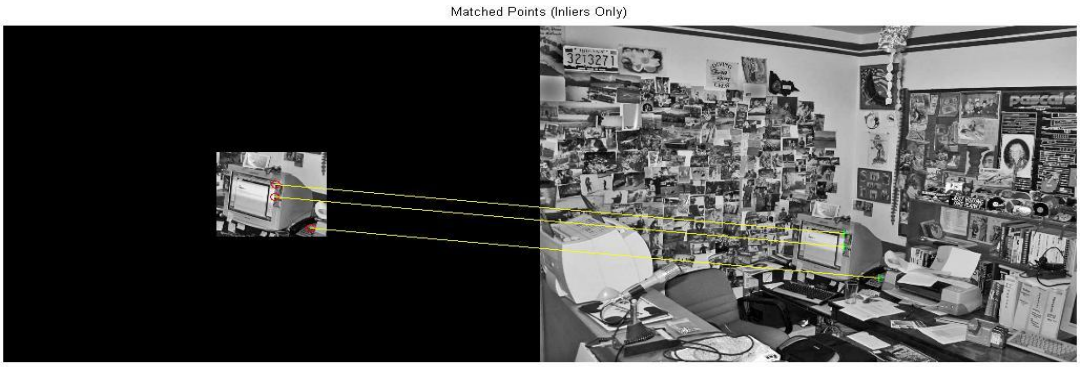

Fig 4.5 Matched Inliers

Fig.4.6 Detected Box

V. PERFORMANCE TABLE

a. Algorithm	b. No. of Detected Points in Actual Image	c. No. of Detected Points in Query Image	d. No. of Matched Points	e. Detected Object	f. Time Taken
SIFT + DWT	2518	129	3	Very Clear	13.018

VI. CONCLUSION AND FUTURE WORK

To extract, detect and match the features count to be consistent with my proposed work using DWT. Using DWT , applying SIFT and Corner detection on decomposed image. I modified the MATLAB computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation MATLAB is an interactive system whose basic data element is an array that does not require dimensioning. This allows you to solve many technical computing problems, especially those with matrix formulations. As one might expect, a good feature based and hidden object made better object recognition and give promising result.

Few other approaches are used in feature based algorithm like hypothesis and test, interpretation tree, pose clustering. pose consistency to find the matches between object features and image feature. Methods that

extract features from the objects to be recognized and the images to be searched surface patches, corners ,linear edges.

Data Set The data set in this thesis is limited to little number of images. As the research is not only related to the object detection, the accuracy is also a part of the research. So limited number of images can be considered here for performing the work.

Geographical Area Cluttered image which are considered in the research are not especially taken to perform a particular task. As the data collection is secondary data, thus the data considered is only the already available data.

Thus in future the work can be done on particular application, by capturing own interested images and videos and apply these techniques on different set of images.

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