Automated Object Recognition From High Resolution Satellite Images: A Review

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Abstract: The aim of object detection is to first localise and then characterise the objects in an images. It is one of the fundamental aspects of scene understanding. The utilization of satellite images nowadays days have been very wide. They give detailed information about the features exhibit in an image[1]. High Resolution Satellite images is used as the automatic feature extraction of features such as buildings, roads, vegetation etc also incorporates collapses. Automated Object Recognition is needed as the execution of a machine is superiorthan the performance of human as their performance degrades with increasing number of targets, whereas the performance of a machine does not depend on the size of set of targets. Also, the performance of a machine does not degrade due to fatigue caused by prolonged effort. A lot of examination is consistently performed to advance this field and to enhance the capability and robustness of object detection systems. So, in this paper we will survey these object detection techniques.

Keywords:

High spatial resolution, Hough Transform, Machine Vision, Template Matching, Object Recognition

[1] Introduction

The aim of this paper is to represent an approach for extracting the knowledge from the image. Computer Vision is the scientific discipline that aims for extracting information from visual data[1]. For computers the image is solely a bunch of numbers. There is a very well-known proverb that “An image is worth a thousand words”. So, to recover these words is the objective of computer vision. Hence, localising the objects is one of the fundamental problem in computer vision and a pre-requisite for higher level tasks such as scene understanding or autonomous robot navigation. Object detection is a major challenge for computers. The task consists in localising objects and annotating them with an object class label. Both parts bear many difficulties. On one hand, a detector must account for potential changes of the object

while simultaneously being robust to altered illumination/imaging conditions. On another hand, objects may appear anywhere in an image with unknown size. Therefore, efficiency is of paramount importance for systems to be of practical relevance. Also prior to object detection we may encounter certain types of difficulties like image may not be clear or there might be some noise in the image.

ISSN: 2278 – 1323

So, to remove these we require certain type of filtering techniques. Also, the object to be detected could be anything like it could be roads and roads are basically the straight lines. So, we have used Hough transformation for detecting road type of objects. The image which are fuzzy i.e not clear, to extract the edges from these images we have used Fuzzy Template Based Edge Detector. And lastly, to recognise any object given the main image and the subimage we have made our Object Detector which will highlight the object in the main image by a bounded rectangle. Hence, we conclude that for Automated Object Recognition we require certain Filtering techniques, Segmentation techniques, Fuzzy Based Techniques and the Object Detector through Template Matching.

[2] Related Work

To extract the boundaries of the image an active contour models were first proposed by **Kass et al.[2]** These are also known as"snakes", a reference that can be attributed to their snakelike morphological movements. Snakes are deformable lines that are adjusted to fit features of interest, which typicallyinclude edges, lines or boundaries. The position of a snake is adjusted according to internal and image forces. Internalforces which are elasticity and stiffness stem from the snake itself and depend on the type of feature being modelled. Image forces originate from the image and indicate the presenceof certain features of interest. These forces are combined into an energy function whichcan be visualized as a dynamic three-dimensional surface across the image face. Theproblem of finding the contour of the feature of interest can now be treated as an energyminimization problem. The contour fitting process is localized, and the contour initialization position is ofvital importance. Inaccurate initialization points could cause sections of the curve todeviate from the intended path into neighboring local minima. Automated seedingalgorithms can be used to detect fitting initialization points.

Zhao Bao-jun and Li Dong[3]proposed an Improved Snake algorithm for complex target's boundary detection. As, the traditional Snake algorithm cannot viably locate the object edge of an image with non-convex shapes or low SNR. They considered the aspects of this sort of picture with complex shapetarget or noise and presents an improved Snake algorithm. The conventional Snake function model and operation strategy are enhanced by increasing new control energy functions,and the influencing weight of these energy factors is taken into consideration. At the same time, a dynamic arrangement for theSnake points is used to adapt different target shapes. Thesimulation results indicate that the new Snake model greatlydecreases the dependence on the Snake point's initialposition and effectively overcomes noise influence. Thismethod enhances the Snake algorithm's ability of recognizing object edge.

Olga Barinova[4] etal had dealt with "Detection of multiple object instances using hough transforms". To detect multiple objects of interest, the methods focussed around hough transform utilize non-maxima suppression or mode seeking in order to locate and distinguish peaks in Hough images. Such postprocessing requires tuning of additional parameters and is often fragile, especially when

ISSN: 2278 – 1323

objects of interest tend to be closely located. In this paper, they developed a new probabilistic framework that is in many ways related to hough transform, sharing its simplicity and wide applicability. At the same time, the framework bypasses the problem of multiple peaks identification in hough images and permits detection of multiple objects without invoking non-maximum suppression heuristics. As a result, the experiments demonstrate a significant improvement in detection accuracy both for the classical task of straight line detection and for a more modern category-level(pedestrian) detection problem.

Q. Ji etal[5] worked on "Randomised hough transform with error propagation for line and circledetection". In this paper, they introduced a new randomised hough transform aimed at improving curve detection accuracy and robustness as well as computational efficiency. Robustness and accuracy improvement is attained by analytically propagating the errors with the image pixels to the estimated curve parameters. The errors with the curve parameters are then used to determine the contribution of pixels to the accumulator array. The computational efficiency is accomplished by mapping a set of points near certain selected seed points that are most likely located on the curve and that produce the most accurate curve estimation. Further, computational advantage is accomplished by performing the progressive detection. This concept can be extended to non-linear curves such as circles and ellipse. The seed points in this method are chosen randomly or chosen for every pixel. For the image with numerous pixels this is time consuming.If wecan discover the best seed pixel on the line before we calculatethe parameters for this line, we do not have to compute line parameters for every pixel. Rather, we can basically utilize the most likely seed pixels to compute the parameters of this curve. This will reduce the computational time incredibly.

Serge Belongie[6] dealt with "Shape Matching and Object Recognition utilizing Shape Contexts". They presented a novel methodology to measuring similarity between shapes and exploit it for object recognition. In their framework the measurement of similarity is preceded by: 1) solving for correspondence between points on the two shapes, 2) utilizing the correspondences to estimate an aligning transform. In order to solve the correspondence problem, they attach a descriptor, the shape context to each point. The shape context at a reference point captures the distribution of the remaining points relative to it, thus offering a globally discriminative characterization. Corresponding points on two similar shapes will have similar shape contexts, enabling us to solve for correspondences as an optimal assignment problem. Given the point correspondences they evaluate the transformation that best aligns the two shapes; regularized thin-plate splines provide a flexible class of transformation maps for this purpose. The disparity between the two shapes is computed as a sum of matching errors between corresponding points, together with a term measuring the magnitude of the aligning transform. They treat the recognition in a nearest-neighbour classification framework as the issue of discovering the stored prototype shape that is maximally similar to that in the image. The primary

ISSN: 2278 – 1323

contribution of their work is a robust and simple algorithm for finding correspondences between shapes. Shapes are represented by a set of points sampled form the shape contours. There is nothing special about the points. They introduces a shape descriptor, the shape context, to describe the coarse distribution of rest of the shape. Finding correspondences between two shapes is then equivalent to finding for each sample point on the other shape that has the most similar shape context.

KavitaAhuja[7] etal worked on “Object Recognition by Template Matching Using Correlations and Phase Angle Method”. Object recognition in computer vision is the task of discovering a given object in an image or video sequence. Humans perceive a lot of objects in images with little exertion, regardless of the fact that the image of the objects may differ somewhat in different viewpoints, in few diverse sizes /scale or even when they are translated or rotated .Objects can even be perceived when they are partially obstructed from view. This undertaking is still a challenge for computer vision systems in general.Object recognition can be observed as a learning problem. To begin with the framework is trained on sample images of the target object class and other objects, learning to differentiate them. Subsequently, when new images are fed the system can sense the presence of the target object class. The object recognition problem might be divided into two basic blocks: low level and high level vision. The low level vision task can be seen as to isolate objects and regions from the given image and similarly extracting other characteristic features from an image. The high level vision means the interpretation of these objects or features in the frame of a reference scene. Template Matching is a Technique used to categorize objects. A template is a small image (sub-image) .The objectiveis to discover occurrences of this template in a larger image that is, you want to find matches of this template in the image. Template matching techniques compare portions of images against one another.Template matching has been a classical approach to the problems of locating and recognizing of an object in an image.

Roger M. Dufour[8] etaldealt with “Template Matching based Object recognition With Unknown Geometric Parameters”. They inspected the issue of locating an object in an image when size and rotation are unknown. At the point when the geometric parameters are unknown previous methods become impractical because the likelihood surface to be minimized across size and rotation has numerous local minima and areas of zero gradient. In this paper, they proposed a new methodology where a smooth approximation of the template is utilized to minimize a well- behaved likelihood surface. A coarse - to fine approximation of the original template using a diffusion-like equation is used to create a library of templates. Utilizing this library, they successively perform minimizations which are locally well- behaved. As point of interest is added to the template, the likelihood surface gains local minima, however past evaluations place us within a well behaved “bowl” around the global minimum, leading to an accurate estimate.

ISSN: 2278 – 1323

[3] How Road Detection Works

In the past few years many researchers have developed techniques that contribute to automatically extract roads so as to prevent human errors.

[3.1] Steps of Proposed Work

Step1: Filtering:
The method of road extraction in certain locations possesses challenge because the spectral reflectance of some of the old buildings resembles the road surface. Such non-road structures need to be removed [9]. Different filtering techniques are implemented which one can use depending upon the kind of image needed to work upon.

Step2: Segmentation:
Segmentation is the process of partitioning the digital image into multiple segments. Various Segmentation techniques are implemented like Snake's Algorithm, Region Growing , Watershed Algorithm.

Step3: Road Extraction:
We have used the Hough Transformation method to extract the roads. As the roads are basically the staright lines so we have focussed our concern to Hough Transformation.

Step4: Display:
The extracted roads are displayed by highlighting lines which could be intersecting or any kind depending upon the image concerned.

[4] How Object Detection using Template matching works?

For this, we have used OPENCV library of MATLAB R2013 for Object Detection.OpenCV is an open source C++ library for image processing and computer vision originally developed by intel and now supported by Willow Garage. It is free for commercial and non- commercial use. It is a library of many inbuilt functions mainly aimed at real time image processing. Now it has several hundreds of image processing and computer vision algorithms which make developing advanced computer vision applications easy and efficient. The OpenCV library gives us a greatly interesting demo for object detection system(called HaarTraining). Thus, we can create our own object classifiers using the functions.

Our proposal is based on object detection through Template Matching. It firstly would read the main image and its object image. Then it would detect the feature point in both the image and store them for future reference. Then, feature descriptors are extracted at the interest point in the main image and the subimage. Then the features will match along with their descriptors.Also, it is quite possible that some of the feature of the subimage is also there in other image. So, now, by using estimate geometric transform method what we do is that we match the relate points and eliminate outliers. i.e ignore those features which are not of the subimage.Now, we get the bounded polygon of the reference image. And at last the subimage is highlighted by a polygon which displays the detected image.

[5] Conclusion

Feature extraction is slow and time consuming process. When the size of the image increases the performance of the system degrades. This paper describes the several methods utilized for object recognition. Remotely sensed data is utilized to localise and characterise the

ISSN: 2278 – 1323

objects in images[10]. Recently, road detection methods are becoming very vital part of vision applications and play a significant role in various applications. Most current research are highlighted and discussed. Based on the study presented here, researchers can choose a framework suitable for their own object detection problems and can optimize the chosen framework for better accuracy. On the whole, object detection is an exciting research problem with still many open challenges.

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ISSN: 2278 – 1323