A Technical Review on Image Corner Detection in Machine Vision

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Abstract

The Close-range photogrammetric and Computer vision relies on image processing techniques in order to obtain the information required for tasks devoted to perceiving, sensing and measuring the world around a machine vision system. Corners are the principal local features in image. In general, they are nothing but the points that may have high-curvature and appear in the intersection of various brightness sections of images. In several image attributes, edges are not altered by means of illumination and those attributes have the feature of rotating invariance. They account only about minimal of 0.05% in the total pixels. These have to be either identified or extracted without sacrificing image information.

Key Words: Corner detection; computer vision; object detection; segmentation; neural network; support vector machine

1 INTRODUCTION

Extracting image corners can reduce the processing of data. Hence, image corner detection have the empirical value and plays a vital role in the scale-space theory, image matching, motion tracking, stereo vision, developing 2D- mosaics, pre-processing stage of...
outline capture systems, image related representation and various additional fields. Detecting corners has long been an area of interest to researchers in image processing. Computer vision can be understood as the science of obtaining reliable, accurate, and useful information from images in order to execute and complete tasks devoted to perceiving, sensing, and interacting with the world around a machine vision system. It is clear from those definitions that corner detection is a basic operation in photogrammetric and computer vision. Corner detection is availed as the premier step of multifold vision tasks such namely SLAM (simultaneous localization and mapping), tracking, image matching and recognition, localization. Hence, a huge number of corner detector mechanisms are found in the literature [1].

The problem of detecting the exact point that describes the corner position in the case of a band limited system should be approached carefully. This problem is of main concern for high-accurate reconstruction. High-precise extraction of corner is a complex process due to several factors:

1. The attitude, position, and orientation of the camera with respect to the object;
2. The interior-orientation of camera;
3. The fluctuations of the illumination; and
4. The camera optics.

Conventional techniques for image corner detection usually fall into 2 categories: those which seek to calculate the second derivative of grey-level variation and those which apply some convolution based approaches. Central to both traditional approaches is that- to compute some scalar measure on the image, the presence of a corner is inferred if the computed measure exceeds some user-defined threshold. In general, there is no principled method to set this threshold; indeed what may be considered an optimal threshold generally varies across a single image. These traditional techniques do not hold invariance to grey-levels at which the corners are presented and robustness to the noise is also a significant factor, particularly for techniques which numerically compute a second derivative.
2 LITERATURE SURVEY

In machine vision, the hard task is nothing but the segmentation of the objects in an image. Generally, the image segmentation will be used in order to locate zones of interest within the image [2]. First, the procedure of conduct starts from division of the real image into many equivalent segments in respect of few of the properties namely gray-level, color and texture. The outputs obtained shall be employed with successive tasks of object classification. Ultimately, the performance of an object recognition and object classification depends on quality of image-segmentation procedure. As per the features used in this paper, they can be equally divided in the two groups such as region-related and edge-related segmentations [34]. In the technical review process of Image-corner detection involved, we found that lot many previous works connected to region-based segmentation or blob-detection were generally proposed. Kawaguchi et al. [5] presents blob-detection analysis used to conduct detection of eyes from face related images of human. The presented algorithm extract blobs by seeking for gray-level peaks and streams acquired from binary oriented image and determine a cost using Hough transform to every pair of blobs. Pair of blobs those have the lowest rate can be chosen as iris of the both eyes. Anyhow, the efficiency of this kind of method always depends on selection of appropriate gray-level threshold in order to be utilized to detect various blobs. The detecting algorithm is not related to meeting up threshold step but employs the property of maxima-lines of areas of interest. A finalized frame-work for detection of interesting blobs in color-domain is furnished in [6].

In the technical review held from [7], a smart vehicle-counting method related to blob analysis in traffic-surveillance is furnished. It consists of highly 3 steps, such as- blob analysis, moving-object segmentation, and vehicle-tracking. The speed of each vehicle will be determined by the analysis of blobs of vehicles. Another such a blob-analysis method used for detecting moving-objects is shown in [8]. The method comprises of 3 steps: symmetric-difference is employed to extract the rough moving-object, analysis of blob is employed to upgrade the model at background, and proposed classification planning is utilized to extract cutting edge. Although these various algorithms are said to work much efficiently and gen-
erate greater-accuracy segmentation results, most of the schemes needs initial information kind of knowledge regarding the zone of interest such as color, size and shape. This information can then be utilized to define parameters in hierarchy of improving the segmentation such as thresholds of intensity, the template size or the window operator size. If there is lack of the accuracy of parameters, the proper segmentations could not be run properly in specified time. But, once the variables are all set to suit a set of the test images, they will be re-adjusted once more when a latest set approaches. Even though in the same images, the issue may be most important while the target object appears in various sizes and uncertain shapes. The examination of only the similarity of areas cannot produce the ultimate result mainly for segmenting-objects from image with the complicated scene, namely- traffic images or objects that comprises of number of parts such as flowers or buildings. The aspect of ordered structures of image is needed to describe and detect various image-corners using some algorithms. Carvalho et al. [9] proposed one method of segmenting yeast-cells related to watershed and scale-space analysis. Calculated node features and trees are developed such as survival-time, gray-scale and shape to perform analysis on image segmentation. The propound method for detecting the corners in [10] employs the scale-space algorithm and Plessey operator in order to perceive image-corners assigned to various scales instead of a certain scale. The final overall solution is obtained as an output by combining the corners which are identified and detected at every point-scale and a tracking-back algorithm is employed to get the exact localization. As a result, the corner response function (CRF) is also computed as a minimum change of gray-level intensity in all possible directions. For corner detection, the morphologic skeleton related method has been proposed by Liu wen-yu [11]. The image source is represented as a polygon and image-corners are acquired through the zero-radius of the maximum plate on the morphological skeleton. Outputs have been obtained by using logical hetero OR operation between the two image-corner sets of image source and its complement set. In this paper, based on successive reviews, we propose methods for detecting corner points in binary, gray and color images using neural network algorithm and support vector machine (SVM) algorithm. The classifiers will be designed and built based on neural network.
The proposed network is expected to exhibit quality to show robustness in performance even against the existence of any noise. A SVM algorithm will be designed and built by using support vectors and feature vectors that represents the critical points within a classification issue that corresponds to the image-corner points on various scales.

3 METHODOLOGY

A good image corner is made as a pre-processing stage with the basis of constructing a robust, efficient and ultra-fast image-corner detector. Hence proper importance will be given to preprocessing. Focus in the research is to address parameters tuning, design of machine-learning algorithms, types of preprocessing or post-processing and trade-offs of performance for more complex feature descriptors which must necessarily occur to make the corner detection efficient. Different types of neural network will be designed in terms of architecture and learning algorithm. Here we will do research to develop method for detecting corner points in binary and gray and color images using neural network. The support vector machine based corner detection algorithm will consists of two phases. In the first phase, the edges of given image are extracted along with an orientation of the maximum intensity change of the edge pixels. Then a support vector machine will be designed on a labeled set of four dimensional feature vectors. To have better performances, different types of kernels like linear kernels and non-linear kernels like polynomial, sigmoid and radial basis functions etc will be analyzed in design of support vector machine [12].

Simulation tool to be used is OpenCV for research and development of proposed research work using python and implementation to be performed on either FPGA or Raspberry-Pi to develop an overall embedded system. The objective of this proposed research work is that- it should be applicable for all images and lens related devices focusing some more applications such as in bio-medical processing, military, etc.
4 EXPECTED OUTCOMES

We expect corner point detection through machine learning and an approach will be developed that has good performance, low resource requirements, and will be well implementable in parallel environments. According to review, solutions were comparable in the form of stability, immunity of noise and complexity measurement through stability-factor, anti-noise factor and execution-time. This research will proposes a new approach to corner detection: combining new hands-on approach to feature detection using machine-learning methods to contribute a strong, robust, high-speed image-corner detection algorithm in order to utilize this in real-time related image processing implementations. Moreover, the better execution and performance of detector in these criteria in respect of the less processing time should also be done, as one of the vital goals of the research is to estimate the most efficient and performing image-corner detection system without giving-up the above listed characteristics. An example of one image-corner detection and image-matching by Harris corner detector [13] is as shown in Fig.1.

Fig.1: Sample result of Harris corner detector

5 SUMMARY

A comprehensive technical review on image corner detection states that- there are numerous expectations that has to be obtained such as better parameters tuning, design of various learning algorithms
and performance trade-offs for more elaborate feature descriptors that should take place to make the corner detection most robust and efficient. The algorithm will not only incorporate the computation of complicated differential image related geometric-operators, but also necessitates to provide solution of detecting image-corners through machine learning methods in machine vision perspective. The efforts will be made to enrich this research with highly quantifying the results with suitable analysis of simulations as well. Upon construction of this overall system, it will have inbuilt learning capability which can in turn result in best performance, better efficiency and high reliability for large range of images. Considerably very less work has been done on comparison and evaluation of feature detectors and hence we are eager to work over this also. The motto of this research is to largely facilitate the various lens oriented applications world-wide through the use of machine-learning algorithms in machine vision that makes the system robust.

References


