Universiti Teknologi MARA
Cawangan Kedah
Kampus Sungai Petani

Voice of Academia

Academic Series of Universiti Teknologi MARA Kedah

VoA 2021
Volume 17 Issue 2

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e-ISSN: 2682-7840

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Voice of Academia
Academic Series of Universiti Teknologi MARA Kedah

Voice of Academia Vol 17 (II) June 2021

Voice of Academia

ISSN: 1985-5079

DETECTION OF THE CORNER POINTS FROM A MAP

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ARTICLE INFO

Article history:

Received Feb 2021
Accepted May 2021
Published June 2021

Keywords:

Corner Detector, FAST, information, Kampung Bukit Kapar

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ABSTRACT

The important points in the image that can view the information and features of the image are known as the corner points. The corner points can be detected by using several techniques. The techniques that involve in the detection of corner points are known as corner detector. In this study, a new technique named FAST Corner Detector is proposed to detect the corner points of Kampung Bukit Kapar map. Detection of corner points accurately is significant to the image processing, which can reduce the noise and much of the calculations. In this study, the initial technique is smoothing the image and extracting the outline of the image. Then, FAST Corner Detector is used to detect the corner points by considering the amount of corner point detection and run time processing.

1. Introduction

Every image has corner points. The corner points are very important in the image processing techniques such as the reconstruction of a curve and surfaces. The technique in corner points detection is implemented in several stages. A different technique is used in order to compile the result of every stage.

The most interesting characteristic extracted from visual images is known as the corner points of the images. Corner points of an image can describe the features and characteristics of the image. The corner points are significant in the image processing techniques such as reconstruction of a curve and surfaces in Computer Aided Geometric Design. Detection of the corner points is still a continuous problem even though it has been investigated using a lot of corner detection techniques. Therefore, the image smoothing and outline extraction should apply a proper technique in order to get the best result of detection corner points.

There are a lot of corner detection techniques that are applied by the researchers in order to determine the best technique that can get accurate corner points. This study proposed Features from Accelerated Segment Test (FAST) Corner Detector to detect the corner points of 2-

dimensional image. The two-dimensional image used in this study is a map of a village named Kampung Bukit Kapar. The process started with smoothing the image and extracting the outline in order to implement the corner detection technique.

2. Literature Review

The corner points are very important in the image processing techniques such as reconstruction of a curve and surfaces. A corner can be described as the intersection of two edges, where the edges are a sharp change in image brightness, Dey et al. (2012).

Pedrosa and Barchelos, (2010) introduced an effective shape corner point detection and a framework that contains smoothing and corner point localisation nonlinear anisotropic diffusion filter. The points are characterised by maximum curvature value. The detection is very important in some applications including object recognition and motion tracking.

In addition, the current approaches have presented high accuracy and simple corner points in sketches such as curves. The article by Albert et al. (2013) represented a robust approach to corner point detection and tangent vertices in parametric cubic curves of the stroke for additional radius function calculation called Tangent and Corner Vertices Detection (TCVD) approach. The approximated piecewise curves are calculated using radius function to obtain curves that is smoother than the curve obtained from discrete radius calculation.

The article from Chen et al. (2016) proposed on the technique of corner detection based on KD curvature for discrete curvature estimation. The corner strength is introduced in controlling detection precision. The results show that KD curvature methods overcome the current detection in both computational flexibility and efficiency of corner detection.

Corner detection can describe the contents of the image and extract certain kinds of characteristics within the used computer vision systems. According to Haggui et al. (2018), corner detection is the main kernel for various procedures of image processing containing a motion detector and pattern recognition. These procedures are the most important role in the analytics of visual big data. Corners are the most interesting characteristic extracted from visual images. Outline extraction and corner point detection are still the open problem even though it has been investigated for decades in computer vision.

As a conclusion, a lot of researchers have conducted the study of corner detection with different techniques and modification is made to overcome the problems. Hence, the study of corner detection is always guided in order to determine the best result.

3. Estimation Method

This study involves several processes in order to achieve the objectives. The processes are displayed in the Figure 1 below:

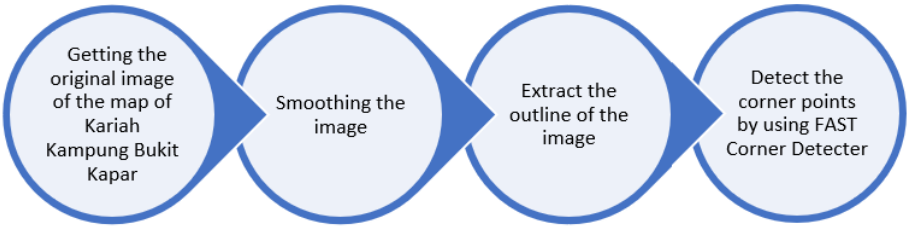

Figure 1: The processes in detecting corner points

In the first step, a two-dimensional image was obtained from the website infobukitkapar.blogspot.com with the title of 'Pelan Sempadan Kariah Kampung Bukit Kapar, Klang, Selangor'. The original image is shown in Figure 2.

Figure 2: The original image
(source: Mohsin, 2018)

Adobe Photoshop CS6 Software was used to remove the noise of the image and by using Gaussian filter, the image converted is smoother than the original. This study applied morphology operation to extract the outline of the image by using erosion operation. Morphology is a broad set of binary image operations that process images based on shapes. Erosion is an operation that 'shrinks' or 'thins' objects in a binary image. The original image is converted to the binary image and the Erosion operation is applied to extract the outline of the image. Outline extraction is the boundary extraction of a digital image from a binary image. Outline extraction is the important process to develop the information and understand the feature of the image (Raseli and Ali, 2012).

Next from the image of outline extraction, the FAST Corner Detector is applied to the image in order to detect the corner points in the image. The technique is implemented by identifying the important points in the image. An indicator is added in the list of other important points detection. Then, only several points will be identified and processed inside the range. Other points outside the interest scope are rejected. The image in Figure 3 shows the closer view of the interest point with 16 pixels on the circle.

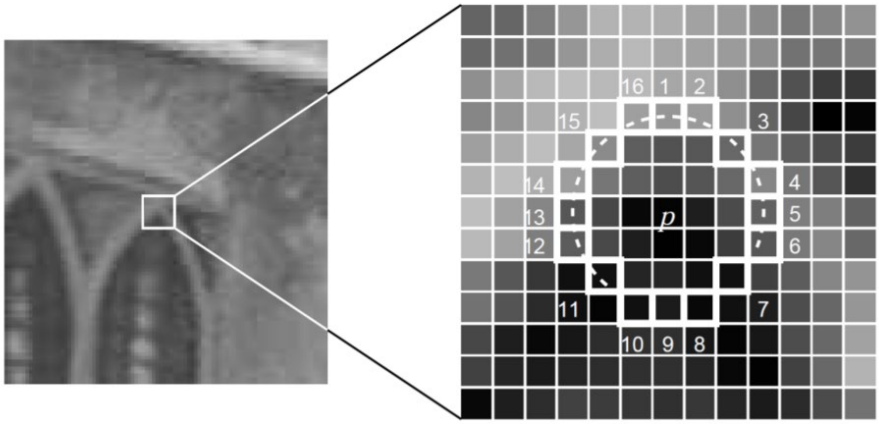

Figure 3: Closer view of the interest point with 16 pixels on the circle. *(Image copied from E. Rosten and T. Drummond, 2006)*

The process involved to detect the corner points started with selecting the image 'p' in the image. The intensity of this image is assumed to be IP. The selected pixel is categorised as a pixel under test. Next, a threshold value T is set (the value is assumed to be around 20% of the pixel under test). A circle of 16 pixels surrounding the pixel 'p' is considered the pixel that has intensity to be IP. For the pixel to be differentiated as a corner point, 'N' adjacent pixels out of the 16 need to be either above or below IP by the threshold value T. In this present case, the 'N' is equal to 12. The detection compares the intensity of pixels 1, 5, 9 and 13 of the circles which is these pixels are located in the compass direction (Rosten and Drummond, 2006). The condition in order to select 'p' as a corner point when at least three of these pixels' values must all be brighter than IP+T or darker than IP-T. The process is repeated for all the pixels in the image.

4. Results and Discussion

The result of the outline from the image is shown in Figure 4. It is extracted by using the Erosion operation.

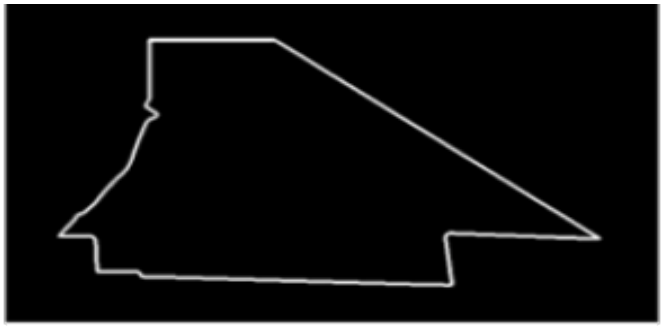

Figure 4: The outline of the image

Then, the Fast Corner Detector is applied on the image resulting in producing corner point detection as shown in Figure 5.

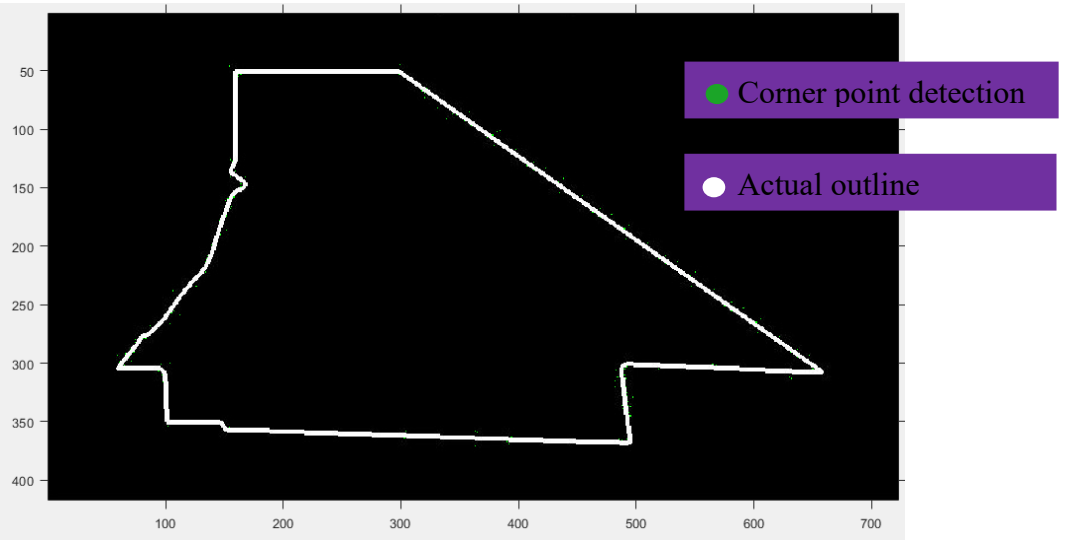

Figure 5: The corners point detected by FAST Corner Detection algorithm.

The corner points are shown by the green dots. The white line is the actual outline of the image. The result of total corner points detected by the corner detector is shown in Table 1.

Table 1. The total corner points detected and the run time of Fast Corner Detector

Algorithm	Corner Point detection	Run Time (sec)
FAST Corner Detection	204	12.0992

FAST Corner Detection is an algorithm to detect the corners using the concept of image gradient. Besides that, FAST Corner Detector can identify the important points in the image. It can be operated in a rate of real time frame applications continuously. A machine learning approach is used in this algorithm to be adapted in processing.

5. Conclusion

The objective in image processing is to increase the quality of image and perform features extraction and categorisation. It is productively used in computer vision, meteorology, medical imaging, remote sensing, astronomy and other related fields, (Saxena et al., 2016). Digital image processing techniques help in operation of the digital images through the use of computer. The method should provide a good result in outline extraction and corner point. Furthermore, it should be a practical model, direct analysis and the most important is the result is easy to understand.

The objective of this research has been successfully accomplished. It shows that FAST Corner Detector can be a proposed method to detect the corner points of an image. FAST Corner Detector is more focused on the corner point in the outline image and get a good result of corner point processing which is 204 point with 12.0992 second.

Acknowledgement

We would like to extend our gratitute to Ketua Kampung Bukit Kapar, En Masadan bin Mohsin for the data contribution of the map of kariah Kg. Bukit Kapar.

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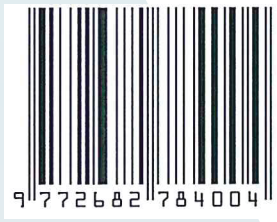

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ISSN: : 1985-5079