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Object Identification Using Manipulated Edge Detection Techniques

Muhammad Yasir[1,*], Md. Sakaouth Hossain[2], Shah Nazir[3], Sulaiman Khan[3], Rahul Thapa[4]

[1]College of Oceanography and Space Informatics, China University of Petroleum, Qingdao, China

[2]Department of Geological Sciences, Jahangirnagar University, Dhaka, Bangladesh

[3]Department of Computer Science, University of Swabi, Swabi, Pakistan

[4]Department of Geography, D.B.S (P.G) College, Dehradun, India

Email address:

yasirupc53@gmail.com (M. Yasir)

[*]Corresponding author

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Abstract: Object detection is a computer vision technique for locating instances of objects in images. Because edge detection techniques are at the forefront of image processing for object recognition, having a thorough grasp of them is essential. Object detection techniques play a significant rule in image processing. The proposed study aims to present different edge detection techniques that include prewitt, Robert, Sobel and canny edge detection techniques. The purpose of this study is to examine several edge detection methods, such as Canny, Sobel, Prewitt, and Roberts, in order to determine the accurate boundary of an object. The research is based on a collection of aeroplane images obtained from the Aeroplane Design and Engineering Database. Based on the analysis and results, it was observed that canny outperforms then other techniques in properly detecting the object, with an accuracy of 98.84%, compared to Sobel 91.75%, Prewitt 83.74%, and Robert 79.45%. When compared to the Sobel edge detection algorithm, prewitt edge detection algorithm, Robert edge detection algorithm, it has been shown that the canny edge detection algorithm delivers superior accuracy in edge detection and execution time. The proposed model's applicability is compared to various generic edge recognition methods such as Sobel, Prewitt, and Robert edge detection approaches, with the conclusion that our model outperforms others in reliably recognizing aeroplane edges in the image.

Keywords: Edge Detection, Object Recognition, Aeroplane Imagery, Matlab

1. Introduction

In recent decades, scientists and researchers have a great demand for image research, one of which is to detect the edge of the image to recognize objects and search for edge information from the image [1]. Image processing edge detection is a basic problem and computer vision is an important task in image processing [2]. The edge of an image is a collection of pixels with vital inequalities, representing significant characteristics of the image and containing information [3]. Edge detection is performed on images whose edges are not symmetrical [4]. Edge detection is one of the most vital technologies in the field of image processing, and has a significant impact on the study of feature extraction, description and subsequent target identification [5]. The purpose of edge detection is to analyze and group feature in the image, and perform further analysis of the image [6]. Edge detection is mainly divided into two parts, namely first-order edge detection and second-order edge detection [7]. The first-order techniques namely; Sobel [8], Prewitt [9], Roberts [10], and Canny [11, 12]. Laplacian of Gaussian (LoG) is the second-order edge detection [13]. The edge detection described in this article is first-order edge detection, such as Canny, Sobel, and Prewitt Roberts methods. Based on these edge detection methods, the results of these methods will be analyzed and compared to be the best and most accurate in recognizing aeroplane imagery.

Several research have used edge detection techniques to solve various problems of the image recognition; this can be seen from the continuous extent of the study related to it. P

Vinista and M M Joe [14] Sobel technique is used for better image edge detection. The several feature of edge detection techniques (Laplacian, Prewitt, Sobel, and Roberts techniques) were studied and analyzed then compared with the Sobel technique with a threshold value of 100. Based on relative analysis, it is found that the Sobel edge detection technique works well as compare to other detection techniques. The outcomes show that the modified Sobel edge detection takes time less to detect the edges of diverse sampled images [14]. R Chetia, et al Introduce an edge detection techniques with improved Sobel quantum method, focusing on non-maximum and dual threshold technologies to present new and improved quantum technique. Edge detection quantum algorithm is realized by analyzing a series of edge pixels, simulation outcomes and circuit complexity. It is further compared with the classical method and several existing quantum edge detection technique. Therefore, the proposed technique can achieve a largely enhance in edge information and circuit complexity [15].

There are several ways for categorizing images, however in the case of high-resolution images, the pixel attribute alone is insufficient. Traditionally, pixel-based hard and soft classifications were utilized, however using image interpretation components can help to generate greater distance between the various geographical characteristics in the image. To categorize the image, this article employs an object-based approach. Different terrain characteristics were categorized in this study, and the total accuracy was about 82 percent, which might be improved by adding more picture interpretation components [16, 17].

This study discusses object-based analysis segmentation methods, including three main approaches: region, boundary, and edge. A process for defining objects is known as segmentation. The entire image was segmented in this process.

This article addresses several object-based analysis segmentation methods, including three main approaches: There are three types of approaches: region, boundary, and edge. The technique of segmentation is the process of defining the items. In the entire image was split in the form of objects. Here is a comparison of these segmentations. Algorithms were demonstrated that aid in the selection of [18, 19] Algorithm for segmentation. After then, edge detection is required to ensure that the border of the object is not crossed. It is possible to identify the thing. A variety of strategies have been used in the past. Canny, Sobel Laplace, and more names are available. But Directionality can be used to change these procedures as well as effective thresholding techniques [20].

On the basis of these related research, this article proposed an edge detection technique for aeroplane image object recognition using Canny, Sobel, Prewitt and Roberts, so that the academic researcher can use it as a reference or information for further research.

2. Database and Methods

In this article used the dataset of aeroplane imagery obtained from the Google open source (https://www.open.edu/openlearn/science-maths-technology/engineering-and-technology/aeroplane-design-and-engineering), Aeroplane Design and Engineering (ADE). The image were obtained in JPG format with a resolution of 1024x578 pixels [21].

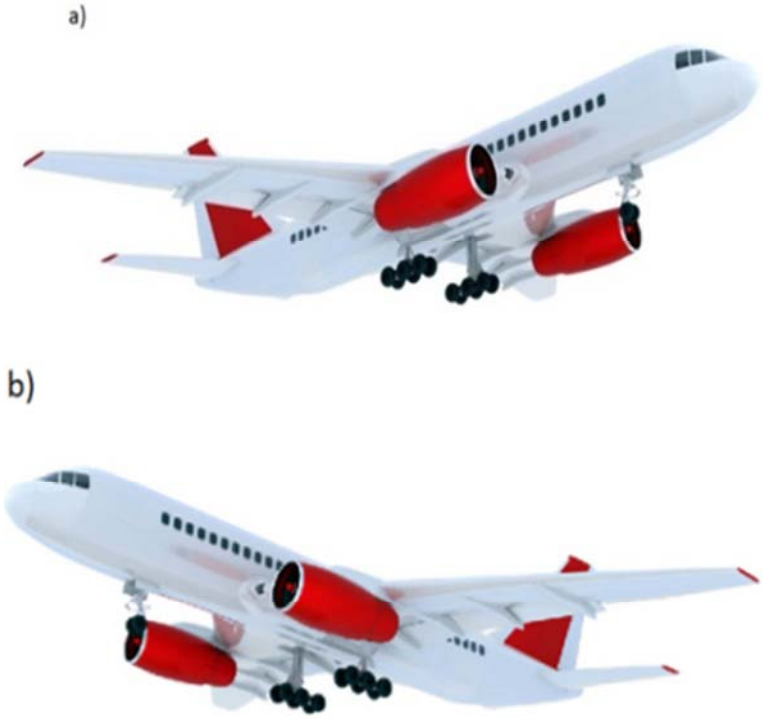


Figure 1. *a) Original image of the aeroplane, b) Flipping horizontal image of the aeroplane.*

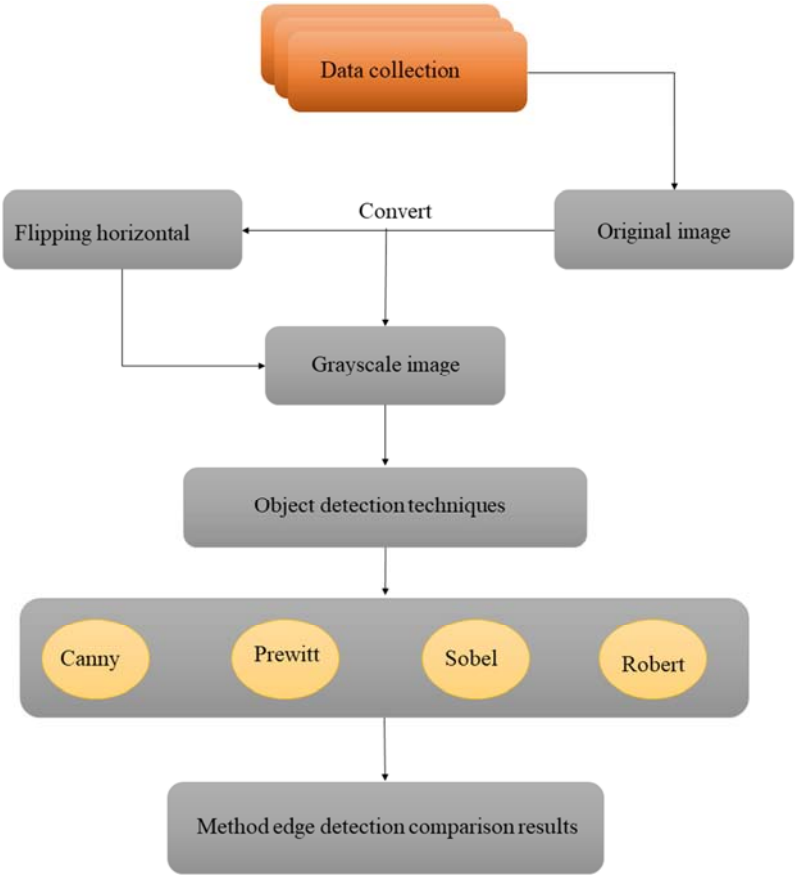
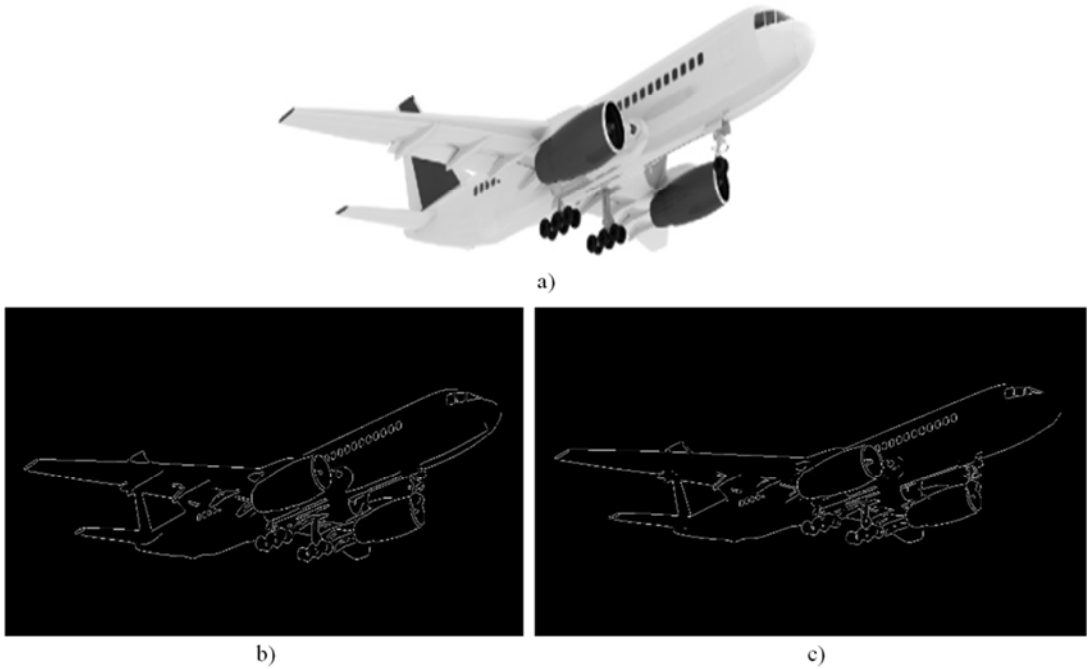
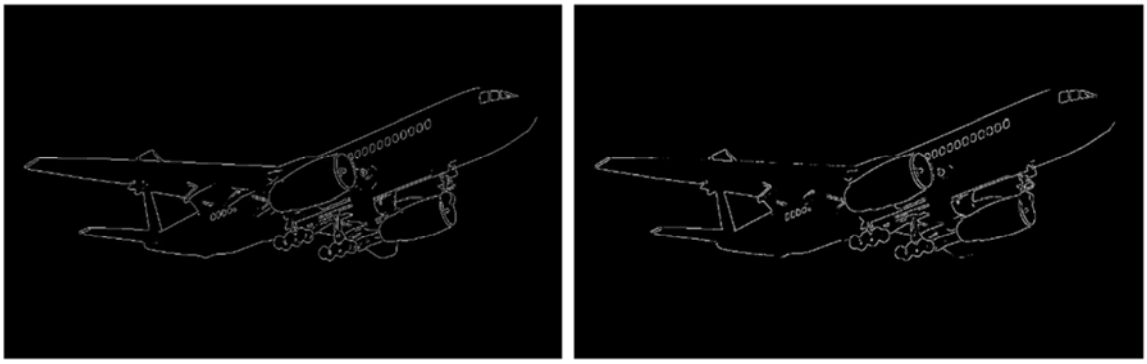


Figure 2. *Proposed methodology.*

First of all used the Matlab platform to flipping horizontally the original images, which will be used for edge detection comparison. Secondly convert the original image into grey scale and then use the edge detection methods to detect the accurate edge boundary of the aeroplane images with different approaches to compare the results. The figure 2 shows the flow of the current research.

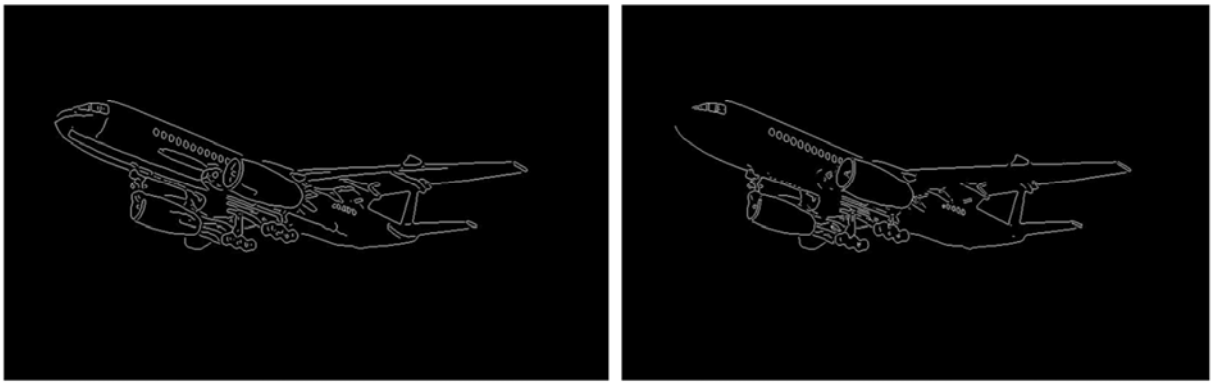




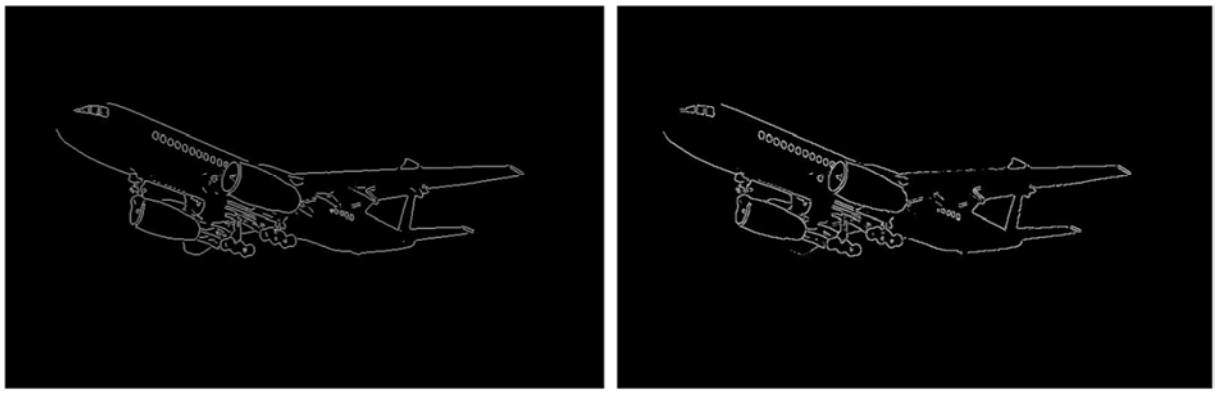
d) e)

Figure 3. *a) Grey scale images, b) Canny, c) Sobel, d) Prewitt, e) Robert.*

a)



b) c)



d) e)

Figure 4. *a) Grey scale images, b) Canny, c) Sobel, d) Prewitt, e) Robert.*

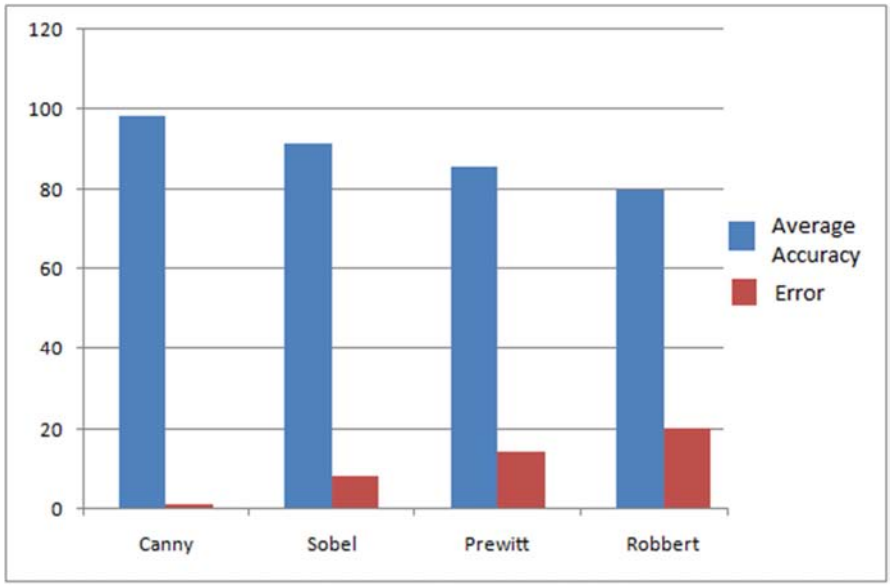


Figure 5. *Show the average accuracy and error of the pixel in percent.*

3. Results and Discussion

The proposed study present different edge detection techniques that includes Canny, Prewitt, Robert and Soble. All of these edge detection techniques are capable of detecting the aeroplane boundary information from the images, but some of these techniques affected by noise (unwanted information in the image processing terminologies). Canny counted one of the optimal edge recognition techniques in our case. It resulted in higher accurate edge detection capabilities along with enriched required information for the simulation purposes. It gives resultant image with high resolution and good edge detection capabilities as shown in figure 3 and figure 4 the results of edge detection. Based on the analysis results, When compared to the Sobel edge detection algorithm, prewitt edge detection algorithm, Robert edge detection algorithm, it has been shown that the Canny edge detection algorithm delivers superior accuracy in edge detection and execution time.

The information display in Figure 5, it can be concluded that the Canny edge detection technique has perform better accuracy than the other generic edge detection techniques such as; Sobel, Prewitt, and Robert edge detection algorithms. This is evidence by the outcomes of image recognition, which is about98.84% better than the other methods, which is about91.75%, 83.74% and 79.45%. For example in southeast coast of Bangladesh, Hossain et al. [12] use these techniques for comparison to extract the coastline and get the accuracy for canny is about 98.70%, and Yasir et al.[11] extract the coastline of Qingdao and get the accuracy for canny is about 97.23%. According to the findings of the experiments, the canny edge detection method outperforms the Sobel edge detection techniques [22], it concluded that overall the canny is consider the best edge detection techniques for detection purpose. Canny counted one of the optimal feature extraction techniques in our case. It resulted in higher accurate edge detection capabilities along with enriched required information for the simulation purposes. It gives resultant image with high resolution and good edge detection capabilities. Besides numerous applications, it has some limitations that listed below:

1. It computational time is very high.
2. It is more complex to develop.
3. Requires more hardware and resources for operational purpose.

4. Conclusion

Artificial object recognition is generally the most important problem in computer vision, and edge detection is the most often used approach. This work describes a robust technique for extracting edge from aeroplane images that is both effective and accurate. Because edge detection is the first stage in object recognition, understanding the distinctions between edge detection approaches is critical. The proposed study aims to present different edge detection techniques that includes prewitt, Robert, Sobel and canny edge detection techniques. All of these edge detection techniques are capable of extracting the coastline information from the remote sensing images, but some of these techniques affected by noise (unwanted information in the image processing terminologies). Based on the analysis results, When compared to the Sobel edge detection algorithm, prewitt edge detection algorithm, Robert edge detection algorithm, it has been shown that the Canny edge detection algorithm delivers superior accuracy in edge detection and execution time. The results of these techniques can help to recognize the object of the aeroplane image even though it has different dimensions and position.

It have been observed that that the Canny edge detection algorithm produces higher accuracy in detection of edges and execution time compared with Sobel edge detection algorithm.

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Data Availability Statement

The data presented in this study are available on given website line (https://www.open.edu/openlearn/science-maths-technology/engineering-and-technology/aeroplane-design-and-engineering).

Conflicts of Interest

The authors declare no conflict of interest.

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