An Approach to Improvise Canny Edge Detection using Morphological Filters

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ABSTRACT
Object detection is a computerized technology related to image processing used in images and videos, to identify instances of real world object. Object detection is usually achieved by edge detection. Edge detection is a process to identify the edges of image by finding the place where intensity changes rapidly. In this experiment an attempt is made to detect the objects by using canny edge detection method in java. The detected objects can be further used for watermarking purpose. The comparison between canny and sobel edge detection is carried out. Morphological filters are used to improve canny edge detection. Contour based learning technique is used to draw contours for detected objects.

Keywords
Canny Edge Detection, Morphological Filters, Object Detection, Sobel Edge Detection.

1. INTRODUCTION
Edge detection is a technique in image processing to identify a curve or a path where intensity changes rapidly. There are many type of edge detection technique like Canny, Sobel, Roberts, Prewitt. Canny edge detection is a non maximum suppression technique based on Gaussian filter.

Morphological filters are collection of non linear operation carried out relatively on the ordering of pixels without affecting their numerical value. Erosion and Dilation are two fundamental operators in morphological filters.

Erosion replaces the current pixel value with minimum value found in defined set of pixels. Dilation replaces the current pixel value with maximum value found in defined set of pixels.

A watermarking is a process of hiding cryptographic information in a host data to protect its ownership and authenticity. To perform watermarking in an image or video, identifying Region of Interest and Object plays a major role. Object Detection is a technique related with computer vision and image processing. In object detection semantic object is identified using edge detection technique.

In this paper section 2 discuss about Literature Survey carried out, section 3 Proposed methodology, section 4 is Result analysis, Conclusion and Future Work is given in section 5.

2. RELATED WORK
In [1], Radhika Chandwadkar et al performed a comparative study on edge detection technique. They claimed canny edge detection overcomes the drawback of Sobel edge detection and they concluded and canny edge detection is better for object recognization and pattern matching.

In [2], Savitha G et al proposed an object detection method in Android devices. They applied Thresholding function to an input image followed by morphological filters. The foreground and background of object is separated. Separated object are stored in array for further work. They concluded canny edge detection technique detects all the edges in a image which is not useful to identify individual object. By the proposed approach largest object is detected and it can be used for tagging of objects in mobile devices.

Bing Wang et al proposed an improved canny algorithm in [3]. In this proposed algorithm, Gaussian filter is replaced by self-adaptive filter, morphological thinning is used to thin the edge and morphological operator is used to achieve the refining treatment of edge point's detection and the single pixel level edge.

Kazlouski et al proposed a new approach of plain object detection based on contour training algorithm in [4]. The vertex is detected in binary image by this contour and closed contours are separated. They concluded experiment extract all the plain objects in an image with more efficiency and less processing time.

In [5] Jammie Shatton et al proposed a new approach of object detection that uses only local contour based features. Two stage supervised learning architecture is proposed. First stage rudimentary detector for small set of segmented image and large trainer set for unsegmented image. The second stage bootstrap detector for improved classifier. They concluded no hand selection part is required and proposed architecture tolerates class variation and occlusion.

Reza Oji proposed a new method for object recognization using full boundary detection in [6]. They combined affine scale invariant feature which contains of six affine parameters like zoom, rotation, translation with 2 parameters and two camera axis orientations with full boundary detection to get best key points. The methodology aimed at finding best key points and they concluded current methodology is very efficient to detect an object with high accuracy.

In [7] Wenzhou Goa et al proposed an improved version of sobel edge detection for images with white Gaussian noise. They combined sobel edge detection with soft threshold with sobel operator. They used soft threshold wavelet mainly to salt and pepper noise and concluded proposed sobel edge detection overcomes drawback of traditional sobel edge detection.

G .T Shrinivakshan et al conducted an experiment to understand fundamental concept of various filter in [8]. They implemented experiment on a image using matlab. The

difference between gradient and laplacian operator is identified. The advantages and disadvantages of filter are studied.

Liu Gang et al proposed a new algorithm for moving target detection in [9]. The proposed system based on traditional three frame differential method. The canny edge detection is combined with proposed system to overcome the drawbacks of traditional three frame differential method and to improvise it. From the experimental result they concluded, the proposed algorithm overcomes empty phenomenon and edge detection problem but still it need to improvise in terms of background changing and filter.

In [10] Cai-Xai Deng et al proposed an improved edge detection algorithm. The proposed algorithm is mainly focused on improvising the ability of canny operator in terms of selection of variance, edge preserving and denoising effects. In this algorithm morphological filter replaces Gaussian filter and conclusion is given that proposed algorithm can filter salt and pepper noise effectively and edge detection accuracy is improved.

In [11] Yubin Dong proposed an improved canny edge detection algorithm. The proposed method uses Gaussian filter. With the simulation result they concluded the proposed algorithm can eliminate noise, preserve more edge information and can be used for the purpose of image retrieval.

In [12] Weibein Rong et al proposed a new canny edge detection algorithm to overcome the drawback of traditional canny edge detection algorithm like sensitive to noise and loosing weak edges. Here they replaced image gradient with concept of gravitational field intensity. Two adaptive thresholds are used, one is based on image gradient magnitude and another on standard deviation. The concluded proposed algorithm holds good for all the kind of images, simple and easy to implement.

3. METHODOLOGY

3.1 Comparative Analysis on Edge Detection Techniques

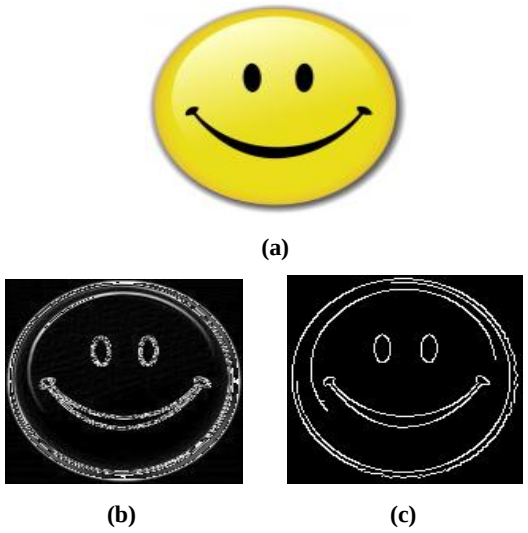
Edge detection is a fundamental tool aimed at identifying transition in host image where brightness changes sharply. It consist set of mathematical methods to extract set of curved line segment called edges. There are many edge detection operators like Canny, Robert, Prewitt, and Sobel.

Sobel operator is a differentiation operator which is used in edge detection technique. It computes approximation of gradient of image intensity function. The resultant image obtained by applying sobel filter will be either norm in vertex or corresponding gradient of input image.

Canny edge detection is an operator that detects wide range of objects in a given image using multi stage algorithm. This multi stage algorithm consist mainly four steps: smoothening, finding gradient, non maxima suppression, hysteresis Thresholding.

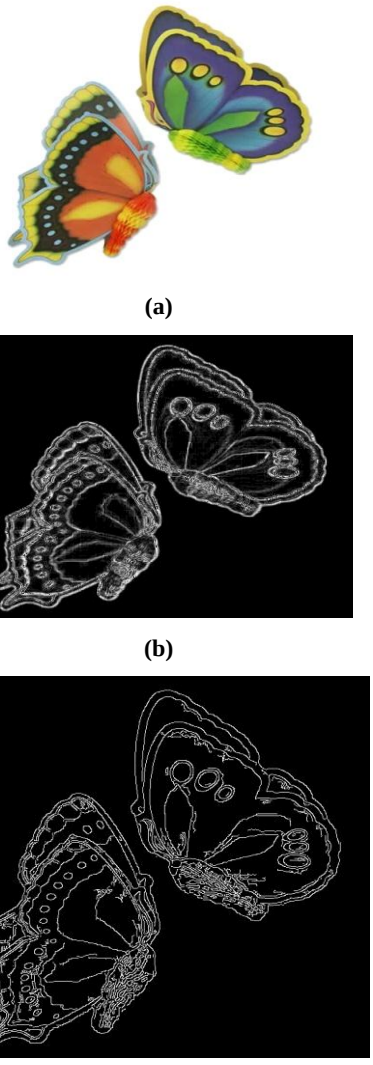
In [1] after conducting canny and sobel edge detection on a sample image they concluded that canny edge detection holds good for object recognization compared to sobel operator and in order to pick a best edge detection algorithm for object detection following experiment is carried out.

The experiment is carried out on two types of image, simple image, with less number of edges and pattern and second one complex image with large number of edges and pattern.



(a) **(b)** **(c)**

Fig 1: Simple image with less number of edges (a) Original image. (b) Sobel edge detection output. (c) Canny edge detection output.



(a) **(b)** **(c)**

Fig 2: Complex image for pattern and large number of edges (a) Original image (b) Sobel edge detection output (c) canny edge detection output

From Fig 1 and Fig 2 it is observed that less number of degraded edges is detected in sobel edge detection and clear pattern is not visible. In canny edge detection very fine edges are detected with clear pattern. The comparative analysis for canny edge detection and sobel edge detection is shown in Table 1.

Table 1 Comparative Analysis of Sobel and Canny Edge Detection Technique with Reference to Fig 1 and Fig 2

Parameter	Sobel	Canny
Computation Complexity[1]	Simple	Complex
Detected Edges	Less no. of degraded edges due to noise increase	Fine edges are detected
Image Pattern	Blur image, no clear pattern detected	Clear image, exact and clear pattern detected
Input Image Complexity	Suitable for simple image with less no. of edges	Suitable for all kind of image

3.2 Morphological Canny Edge Detection

Mathematical morphology is an image extraction tool based on set theory. It is collection of non linear process used to remove unwanted small details. A configuration of pixels of different shape and size defined with 0 and 1 called structural element plays an important role in mathematical operation.

Morphological Filters have two basic functions: Erosion and Dilation.

Open Filter: Opening is a morphological filter where erosion is followed by dilation. It removes noise, round corner from inside and simplifies the image.

Open (src,element)=dilate(erode(src,element));[2]

Closing Filter: Closing is a morphological filter where dilation is followed by erosion. It smoothens the contour and maintains shape and size of object.

Close (src,element)=dilate(erode(src,element));[2]

From the above experiment is proved that canny edge detection is better edge detection technique. But as discussed in [2] it detects very fine edges which are not helpful in identifying individual object which can be further used for watermarking technique. In aim to reduce the number of edges in canny edge detection and to get a prominent object following methodology is carried out in Java with OpenCV.

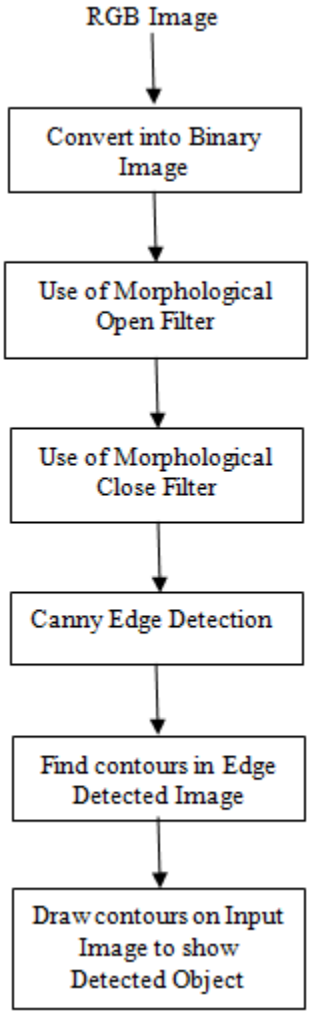


Fig 3: Proposed Method

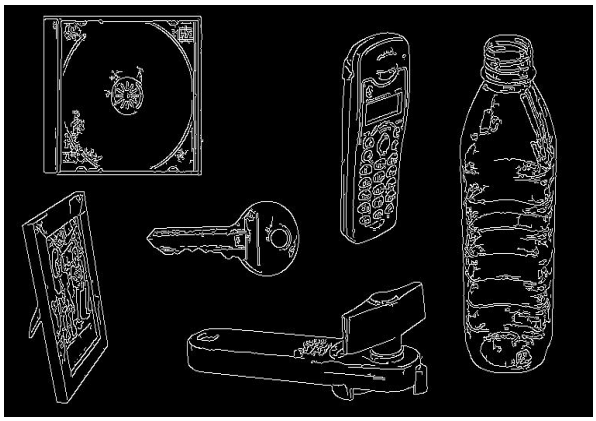
The method proposed in this paper contains following procedure:

1. A RGB image is taken as input and it is converted into binary image.
2. Morphological opening filter is applied to binary image using OpenCV in Java.
3. Close Filter is applied to open filtered image using OpenCv function.
4. On open and close filtered image, Canny Edge detection algorithm is applied.
5. Contours are found from edge detected image and numbers of contours are counted.
6. To indicate the identified object using Canny Edge Detection with less number of edges, Contours are drawn on original image.

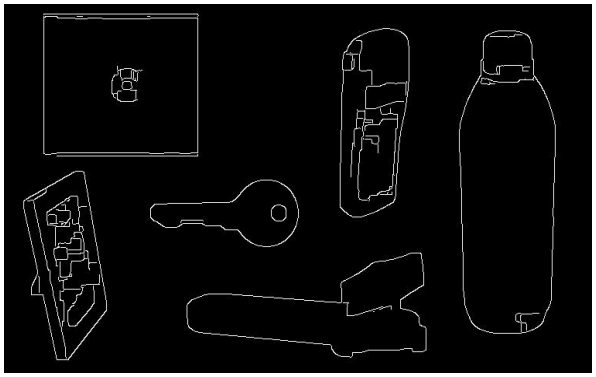
4. RESULT ANALYSIS

In the current experiment, identification of object is achieved using morphological operation and canny edge detection technique. The aim of this experiment is to reduce the number of edges detected in simple canny edge detection algorithm by which we can identify prominent object.

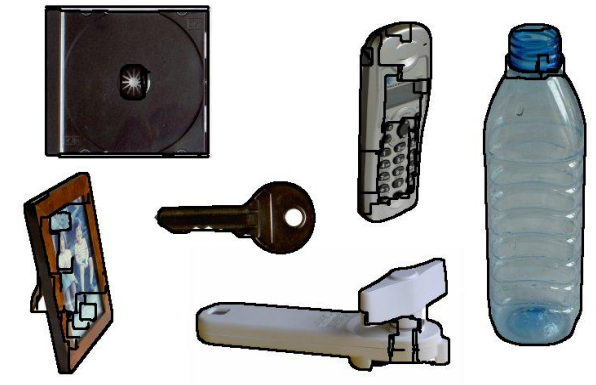
(a)



(b)



(c)

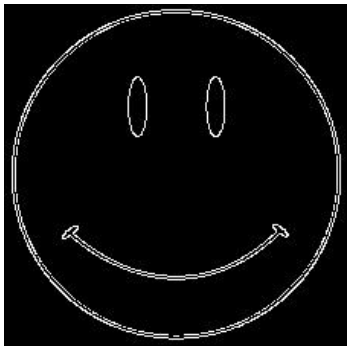


(d)

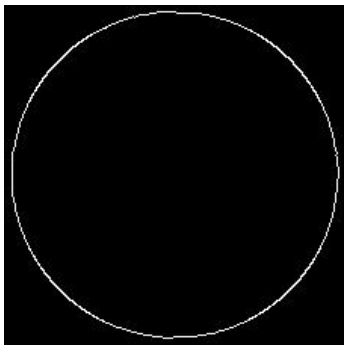
Fig 4: Complex image with more number of edges (a) Original image (b) Simple canny edge detection output (c) Morphological canny edge detection output (d) Identified Objects shown on original image

Fig 4(a) Represent a complex image with more than one object, Here in Fig 4. (b) We can observe that fine and more number of edges are detected in simple canny edge detection algorithm and the numbers of edges are reduced in Fig 4. (c) Fig 4 (d) identified objects are marked.

(a)



(b)



(c)

(d)

Fig 5: Simple image with less number of edges (a) Original image (b) Simple canny edge detection output (c) Morphological canny edge detection output (d) Identified Objects shown on original image

Fig 5 (a) Represent a simple image with less no. of edges, Here in Fig 5(b) We can observe that fine and more number of edges are detected in simple canny edge detection algorithm and very less number of edges are detected in Fig 5 (c) Fig 5(d) identified objects are marked.

The number of contours detected in simple canny edge detection and morphological canny edge detection is shown in Table 2. And it is observed that there is huge difference between the numbers of contours identified. Our aim was to reduce number of fine edges detected by simple canny edge detection and it is seen that number of edges detected is reduced and identified object can be used for further watermarking.

Table 2 Comparative Analysis of Simple Canny Edge Detection and Morphological Canny Edge Detection Technique

Image type	Contours in Simple Canny Edge detection	Contours in Morphological Canny Edge detection
Simple Image, Fig 5	**117**	**2**
Complex Image, Fig 4	**542**	**45**

5. CONCLUSION AND FUTURE WORK

The traditional canny edge detection algorithm has capability of identifying very fine edges which cannot be used for prominent object detection. In this paper, Object identification achieved using Morphological canny edge detection in java OpenCV. The comparison between sobel edge detection and canny edge detection is carried out. From experimental results canny edge detection is proved as better. Canny edge detection is combined with morphological operation to identify prominent object with less number of edges and it is observed in experimental result that number of edges detected in proposed approach is less compared to simple canny edge detection. Prominent objects are detected and it can be further used for watermarking or any other application that involves object detection. The proposed approach is not applicable for image with overlapped objects so the future work will be on identifying prominent object in overlapped objects with less number of edges.

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