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# Review of Object Segmentation and Identification Using Edge Detection and Feature Matching Technique

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**ABSTRACT**

Image Segmentation is the process of dividing an Image into multiple parts. This is used to identify object or other relevant information in digital images. Object Identification is the process of finding a given object in an image or video sequence. In this paper, interaction between segmentation using different edge detection method and identification.In this paper we present method for Edge detection such as Sobel, Prewitt, Roberts ,Canny methods and Active Contour are used for Segmenting the Object. Object Identification Technique such as Interest Point Matching and Putative Feature Matching Technique.In this paper these technique applied on the Elephant images to choose base guesses for Segmentation and Identification. These Technique is useful for Segment and Identified the Object (Elephant) that is useful to prevent the attack on human,raid of crops and destruction of property by elephant.

**Key words :**Image Segmentation, Object Identification, Edge Detection Method, Active Contour Technique, Interest Point Matching Technique, Putative Feature Matching Technique.

## 1.INTRODUCTION

Image segmentation is the foundation of object recognition and computer vision. In general,image noise should be eliminated through image pre processing. Image segmentation has become a very important task in today's scenario. Image segmentation is a fundamental process in many image, video, and computer vision applications [1].There is some specifically given work (such as region extraction and image marking) to do after the main operation of image segmentation for the sake of getting better visual effect. Two major computer vision problems, image segmentation and object identification.Image segmentation is the process of partitioning/subdividing a digital image into multiple meaningful regions or sets of pixels regions with respect to a particular application. The segmentation is based on measurements taken from the image and might be grey level, colour, texture, depth or motion. The result of image segmentation is a set of segments that collectively cover the entire image. All the pixels in region are similar with respect to some characteristic or computed property, such as color, intensity, or texture [3]. Adjacent regions differ with respect to same characteristics. Edge detection and Active Contour Technique is the frequently used techniques in digital image processing.Object recognition is the task of finding a given object in an image or video sequence. For any object in an image, there are many 'features' which are interesting points on the object that can be extracted to provide a "feature" description of the object [3]. This description extracted from a training image can then be used to identify the object when attempting to locate the object in a test image containing many other objects.Image segmentation is done using various edge detection techniques such as Sobel, Prewitt, Roberts, Canny and Active Contour Technique.Object Identification is done using Interest Point Matching and Putative Feature Matching Technique.

## 2. SEGMENTATION

Segmentation is the process of partitioning a digital image into its constituent parts or objects or regions. These regions share common characteristics based on color, intensity, texture, etc [3]. The first step in image analysis is to segment an image based on discontinuity detection technique (Edge-based).In discontinuity detection technique, one approach is to partition an image based on abrupt changes in intensity near the edges and it is known as Edge-based segmentation.

### 2.1 Edge Detection Technique

An edge may be defined as a set of connected pixels that forms a boundary between two disjoints regions.Edge detection is basically, a method of segmenting an image into regions of discontinuity. Edge detection plays an important role in digital image processing and practical aspects of our life [4].Edge detection is the name for a set of mathematical methods which aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities Edge detection is a basic tool used in image processing, basically for feature detection and extraction, which aim to identify points in a digital image where brightness of image changes sharply and find discontinuities [2].

The purpose of edge detection is significantly reducing the amount of data in an image and preserves the structural properties for further image processing. In a grey level image the edge is a local feature that, with in a neighborhood separates regions in each of which the gray level is more or less uniform with in different values on the two sides of the edge**.** The process of partitioning a digital image into multiple regions or sets of pixels is called image segmentation. Edge is a boundary between two homogeneous regions. Edge detection refers to the process of identifying and locating sharp discontinuities in an image [2].

For a noisy image it is difficult to detect edges as both edge and noise contains high frequency contents which results in blurred and distorted result.In this paper we studied various edge detection techniques as Prewitt, Robert, Sobel, and Canny operators.Edge detection makes use of differential operators to detect changes in the gradients of the grey levels.The edge widely exists between objects and background,objects and primitives.

It contains rich information, step property, shape etc, which is able to describe the target object. There are two types of edge detection: one is step change edge whose pixels grayscale of two sides have significantly difference; the other one is roof edge that is the turning point from increase to decrease of gray value [6].

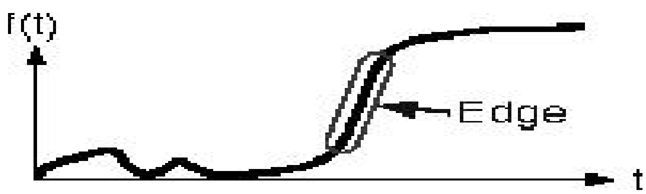



**Figure 1**:First Derivative

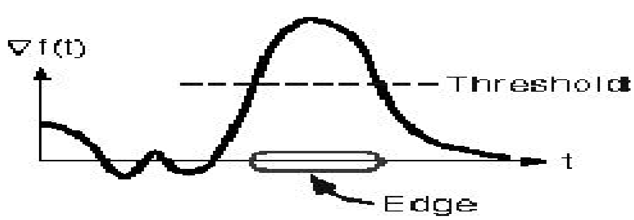



**Figure 2:** Second Derivative

### 2.1.1 Sobel edge detection

The Sobel edge detection method is introduced by Sobel in 1970. The Sobel method of edge detection for image segmentation finds edges using the Sobel approximation to the derivative. It precedes the edges at those points where the gradient is highest [1].

The Sobel methods find edges using the sobel approximation to the derivative.It returns edges at those points where the gradient of image is maximum.The Sobel operator performs a 2-D spatial gradient measurement on an image and so emphasizes regions of high spatial frequency that correspond to edges. Typically it is used to find the approximate absolute gradient magnitude at each point in an input grayscale image.The operator consists of a pair of 3×3 convolution kernels. One kernel is simply the other rotated by 90°. The kernels can be applied separately to the input image, to produce separate measurements of the gradient component in each orientation [7] [8].Mathematically, the operator uses two 3×3 kernels which are convolved with the original image to calculate approximations of the derivatives - one for horizontal changes, and one for vertical. If we define A as the source image, and Gx and Gy are two images which at each point contain the horizontal and vertical derivative approximations, the computations are as follows:

$$G_y = \begin{bmatrix} +1 & +2 & +1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix} * \text{A} \quad \text{and} \quad G_y = \begin{bmatrix} -1 & 0 & -1 \\ +2 & 0 & -2 \\ +1 & 0 & -1 \end{bmatrix}$$

The x-coordinate is here defined as increasing in the "right"-direction, and the y-coordinate is defined as increasing in the "down"-direction. At each point in the image, the resulting gradient approximations can be combined to give the gradient magnitude, using :

$$\text{G} = \sqrt{{G_x}^2 + {G_y}^2}$$

Using this information, we can also calculate the gradient's direction:

$$\theta = arctan\left(\frac{G_y}{G_x}\right)$$

where, for example, Θ is 0 for a vertical edge which is darker on the left side.

The result of the Sobel operator is a 2-dimensional map of the gradient at each point. It can be processed and viewed as though it is itself an image, with the areas of high gradient (the likely edges)

### 2.1.2 Roberts edge detection

The Roberts edge detection is introduced by Lawrence Roberts (1965). The Roberts Cross operator performs a simple, quick to compute, 2-D spatial gradient measurement on an image [1]. The input to the operator is a gray scale image the same as to the output is the most common usage for this technique. Pixel values in every point in the output represent the estimated complete magnitude of the spatial gradient of the input image at that point. The Roberts method finds edges using the Roberts approximation to the derivative.

It returns edges at those points where the gradient of `image` is maximum.The operator consists of a pair of 2×2 convolution kernels as below:

$$G_{x=}\begin{bmatrix}1 & 0\\ 0 & -1\end{bmatrix} \text{ and } G_Y=\begin{bmatrix}0 & 1\\ -1 & 0\end{bmatrix}$$

The kernels can be applied separately to the input image, to produce separate measurements of the gradient component in each orientation (*Gx* and *Gy*) [8].
The gradient magnitude is given by:

|G| = |Gx| + |Gy| or by using |G| = sqrt(Gx * Gx + Gy * Gy).

The angle of orientation of the edge giving rise to the spatial gradient (relative to the pixel grid orientation) is given by:

$\theta = \arctan (Gy / Gx) - 3\pi / 4$.

The Roberts edge detector is a simple operator. The vectorization of this operator allows for a better performance on color images than of the intensity values alone.

### 2.1.3 Prewitt edge detection

The Prewitt edge detection is proposed by Prewitt in 1970. Prewitt operator edge detection masks are the one of the oldest and best understood methods of detecting edges in images [1]. The Prewitt edge detector is an appropriate way to estimate the magnitude and orientation of an edge. The Prewitt operator uses the same equations as the Sobel operator, except that the constant c = 1. The Prewitt method finds edges using the Prewitt approximation to the derivative. It returns edges at those points where the gradient of `Image` is maximum.The Prewitt operator consists of a pair of 3×3 convolution kernels as below**:**

$$G_{X=}\begin{bmatrix}-1 & 0 & 1\\ -1 & 0 & 1\\ -1 & 0 & 1\end{bmatrix} \text{ and } G_{Y=}\begin{bmatrix}1 & 0 & 1\\ 0 & 0 & 0\\ -1 & -1 & -1\end{bmatrix}$$

The Prewitt operator measures two components. The vertical edge component is calculated with kernel Gx and the horizontal edge component is calculated with kernel Gy. |Gx| + |Gy| give an indication of the intensity of the gradient in the current pixel.

### 2.1.4 Laplacian of gaussian

Laplacian of a Gaussian function is referred to as LoG. The Laplacian of Gaussian (LoG) was proposed by Marr and Hildreth (1980). The Gaussian filtering is combined with Laplacian to break down the image where the intensity varies to detect the edges effectively [1]. The Laplacian is usually used to establish whether a pixel is on the dark or light side of an edge. The Laplacian is a 2-D isotropic measure of the 2nd spatial derivative of an image.

The Laplacian of an image highlights regions of rapid intensity change and is therefore often used for edge detection. The Laplacian is often applied to an image that has first been smoothed with something approximating a Gaussian Smoothing filter in order to reduce its sensitivity to noise. The operator normally takes a single gray level image as input and produces another gray level image as output. The LoG of an image f(x, y) is a second order derivative defined as

$$\nabla^2 f = \frac{\delta^2 f}{\delta x^2} + \frac{\delta^2 f}{\delta x^2}$$

It has two effects, it smoothes the image and it computes the Laplacian, which yields a double edge image. Locating edges then consists of finding the zero crossings between the double edges. The digital implementation of the Laplacian function is usually made through the mask below.

$$G_{X=}\begin{bmatrix}0 & -1 & 0\\ -1 & 4 & 1\\ -1 & -1 & 0\end{bmatrix} \text{ and } G_{Y=}\begin{bmatrix}-1 & -1 & -1\\ -1 & 8 & -1\\ -1 & -1 & -1\end{bmatrix}$$

### 2.1.5 Canny Edge Detection

The Canny method finds edges by looking for local maxima of the gradient of image. The gradient is calculated using the derivative of a Gaussian filter. The method uses two thresholds, to detect strong and weak edges, and includes the weak edges in the output only if they are connected to strong edges [7]. This method is therefore less likely than the others to be fooled by noise, and more likely to detect true weak edges.Canny proposed three criteria of the evaluation the pros and cons of performance of edge detection: (1)standard of ratio of signal to noise, that is real edge detection probability is higher and non-edge points sentenced to be lower the probability of edge points, so that the output of ratio of signal to noise is maximum; (2) standard of positioning accuracy, that is there is great possibility that the detected edge points is actually in center of the edge; (3) The unilateral corresponding standard, that is the probability of multiple response in single edge is low, and false edge The response should be the maximum inhibition.Canny technique is very important method to find edges by isolating noise from the image before find edges of image,without affecting the features of the edges in the image and then applying the tendency to find the edges and the critical value for threshold.

Canny algorithm is not susceptible to noise interference enables its ability to detect true weak edges. It's optimal edge detection algorithm [7].
The algorithmic steps for canny edge detection technique are follows:

1.Convolve image f(r, c) with a Gaussian function to get smooth image f^(r, c).

$$f\hat{}(r, c)=f(r,c)*G(r,c,6)$$

2. Apply first difference gradient operator to compute edge strength then edge magnitude and direction are obtain as before.

3. Apply non-maximal or critical suppression to the gradient magnitude.

4. Apply threshold to the non-maximal suppression image.

### 2.1.6 Active Contours Technique

Active Contour is technique for image segmentation. An advantage of active contours as image segmentation methods is that they partition an image into sub-regions with continuous boundaries. There are two kinds of active contour models: Edge-based active contours use an edge detector, usually based on the image gradient, to find the boundaries of sub-regions and to attract the contours to the detected boundaries [3]. Region-based active contours use the statistical information of image intensity within each subset instead of searching geometrical boundaries. Segment image into foreground and background using active contour [3].
bw = activecontour(A,mask) segments the 2-D grayscale image A into foreground (object) and background regions using active contour based segmentation. The output image bw is a binary image where the foreground is white (logical true) and the background is black (logical false). mask is a binary image that specifies the initial state of the active contour. The boundaries of the object region(s) (white) in mask define the initial contour position used for contour evolution to segment the image. To obtain faster and more accurate segmentation results,specify an initial contour position that is close to the desired object boundaries.bw = activecontour(A,mask,n) segments the image by evolving the contour for a maximum of n iterations.examplebw = activecontour (A,mask,method) specifies the active contour method used for segmentation, either 'Chan-Vese' or 'edge'. example bw or evolving the contour for a maximum of n iterations using.A method activecontour using. A method activecontour segments the image using the specified smoothfactor. smoothfactor controls the degree of smoothness or regularity of boundaries of the segmented regions. Higher values produce smoother region boundaries but can also smooth out finer details. Lower values allow more irregularities (less smoothing) in the region boundaries but allow finer details of the region boundaries to be captured.

## 3. COMPARIONS OF EDGE DETECTION TECHNIQUE

We used different natural images to experiment using Robert, Sobel, Prewitt and Canny Edge Detection techniques. Different edge detection techniques work better under different conditions. There are some differences between various Edge Detection Techniques for natural image segmentation as below:

- The Roberts, Sobel and Prewitt operators use the first derivative, while LoG uses Second derivative.

- Prewitt is very similar to sobel but difference is that Sobel edge detector marks a lot of number of pixels while the Prewitt edge detector marks a few number of pixels.

- The Roberts operator use 2×2 masks, while Sobel, Prewitt and LoG use 3×3 masks.

- The Roberts, Sobel and Prewitt operators/Edge detections have very simple calculation to detect edges and their orientation but they have inaccurate detection sensitivity in case of noise because the subjective evaluation of edge detection result images show that under noisy condition Roberts, Prewitt and Sobel operator have poor quality.

- LOG can finding the correct places of edges and test wider area around the pixel but malfunctioning at corners, curves and where the gray level intensity function varies and it do not find the orientation of edge.

- The greater the threshold is, the clearer image edge processing effect is and the more coherent the edge points are significant.However, when the threshold is over 0.3, the effective information of the image edge will be lost. We can see that Canny algorithm is best Sobel, Prewitt, Roberts and Log algorithms. Because Canny can filter noise and maintain the integrity of valid information. Canny operator also can ensure high positioning accuracy of the image. And other operators are more sensitive to noise than Canny, and cannot be filtered.

- We can see that Active Contour is best among all these algorithms because its partition an image into sub-regions with continuous boundaries.The result is best on continous boundaries.

## 4. OBJECT IDENTIFICATION

Object Identification is the task of finding a given object in an image or video sequence. For any object in an image, there are many 'features' which are interesting points on the object that can be extracted to provide a "feature" description of the object. This description extracted from a training image can then be used to identify the object when attempting to locate the object in a test image containing many other objects.Object Identification is done using Interest Point Matching and Putative Feature Matching Technique.

### 4.1 Interest Point Matching

Find the corresponding interest points between a pair of images using local neighborhoods.

Step 1: Read the two stereo images using imread function in matlab and converting these images into grayscale with the help of rgb2gray function.

Step 2: Find the corners point of above grayscale images using detectHarrishFeatures function in matlab.

Step 3: Extract the neighborhood features of these images using extractFeatures function in matlab

Step 4: Match the features of these two images using matchFeatures function in matlab tool.

Step 5: Retrieve the locations of corresponding points for each image.

Step 6: Visualize corresponding points. You can see the effect of translation between the two images despite several erroneous matches using showMatchedFeatures function in matlab tool.

### 4.2 Putative Feature Matching Technique

Find the corresponding points between two images that are rotated and scaled with respect to each other.

Step1 : Read the Reference Image using imread function and convert this image into grayscale image using rgb2gray function of matlab tool .

Step 2: Reading the scene Image in which object has to be detected.

Step 3: Detect the feature point in both images using detectSURFFeatures function and visulaize the strongest features points in the reference image(source image) and scean image(target image) using selectStrongest function in matlab tool.

Step 4: Extract feature descriptors at the interest points in both images using extractfeatures function of matlab.

Step 5: find the putative point matches using matchFeatures and showMatchedfeatures function in matlab tool.

Step 6: Display the detected object using imshow nad line function of matlab tool.

## 5. EXPERIMENTS VERIFICATIONS

Testing Procedure: These edge detection segmentation technique and object identification technique were implemented using(MATLAB R2013b) and tested on elephant image illustrated in Figure 3.

**Figure 3:** Elephant image

The performance results applied by Edge Detection Segmentation Techniques illustrated in the Figure.4

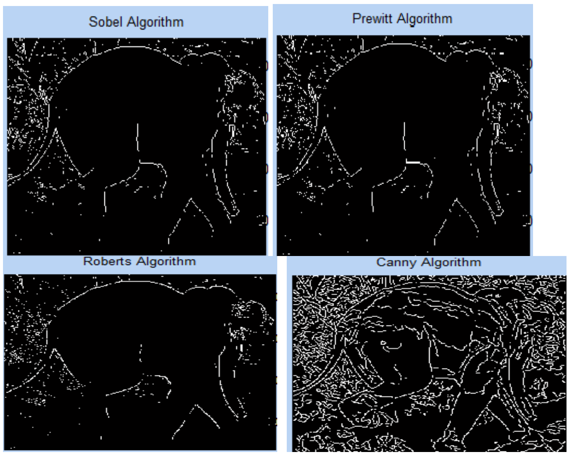



**Figure 4:** Edge Detection Technique

The performance results applied by Active Contour Tehnique the Figure 5.


**Figure 5:** Active Contour Segmentation Technique

The performance results applied by Object Identification Interest Point Mathing Tehnique in the Figure 6.

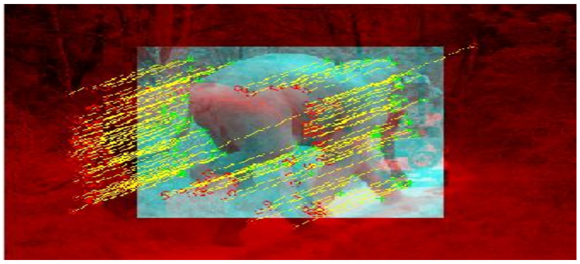
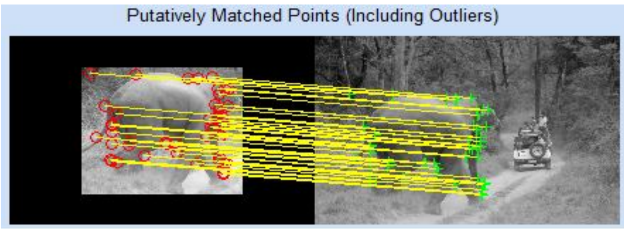


**Figure 6 :** Interest Point Matching Identification Technique

The performance results applied by Object Identification Putative Feature Matching Tehnique in the Figure 7



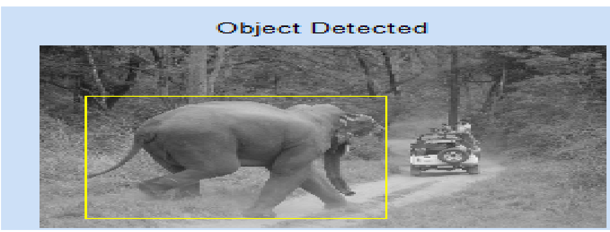




**Figure 7:** Putative Feature Matching Identification Technique

## 6. APPLICATION

- **Security:** Denoising image in order to identify a crime suspect whose picture was taken by either a poor camera or in a poor condition [9] .
- **Medicine :** To clean image in order to have a clear understanding of the part of the body that was snapped (e.g. X-rays) [9].
-
- **Astronomical Aplication:** Image taken from space by satellites [9].
- **Forest Based Application:** To develop application that identified and segment the special object (Elephant) and determine the direction of the object according to movement angle.If the object passes outside the boundry of forest then send the message or trigger warning to the related forest rangers that appropriate action can be taken timely.

## 7. MATLAB

The name MATLAB stands for matrix laboratory. MATLAB is a software program that allows us to do data manipulation and visualization, image analysis, calculations, maths and programming. It can be used to do very simple as well as very sophisticated tasks.

## 8. CONCLUSION

The edge detection is the primary step in identifying an image object, it is very essential to know the advantagesand disadvantages of each edge detection filters [5]. In this paper we dealt with study of edge detection techniquesof Gradient-based and Laplacian based. Edge Detection Techniques are compared with case study of identifyinga Elephant type.In this paper, the comparative studies applied by using five techniques of edge detection segment: Sobel, Prewitt, Roberts,Canny,Laplacian and Putative Point Matching on the Elephant original image Figure.3.A comparative study are explained & experiments are carried out for different techniques respectively are the best techniques for edge detection this result can be seen in the Figure.4 and Figure.5 for segmentation and identification result are explained in terms of Interest Point Matching tand Putative Point Matching Technique this result can be seen in the figure.6 and figure.7.

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