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Importance of Edge Detection in Modern Era

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***Abstract*—** We know that the edge is a fundamental thing of any object. There is no object in this world without edge. Sometimes we can say edge is also known as a corner of an object. We can create any shape of object with the help of the edges. If we look into technically, an edge may be defined as a set of connected pixels that forms a boundary between two disarrange regions. Edge detection is a method of segmenting an image into regions of conclusion. That's why we can say that the edge detection is also known as corner detection or shape detection. If edge is detected shape is also detected. Edge detection or corner detection plays very important role in digital image processing and practical aspects of our life. In this report, we studied various edge detection techniques as Robert, Sobel and Canny operators.

Keywords- *Edge Detection, Shape Detection, Corner Detection, Image Processing*

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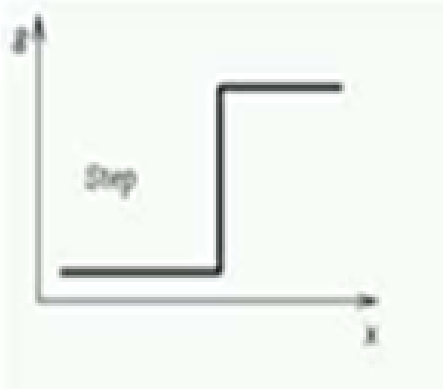
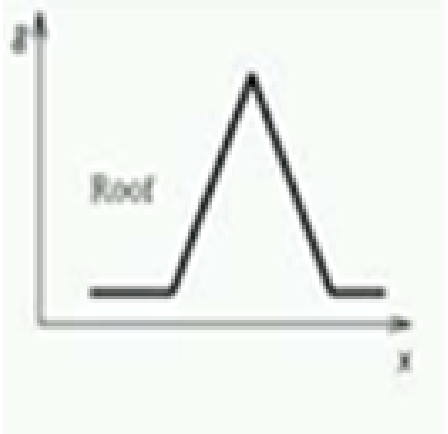
I. INTRODUCTION

Edge detection is a set of mathematical methods to identifying points in a image at which the image intensity like brightness can changes and varies or more sharply.

We can create any shape of object with the help of the edges. If we look into technically, an edge may be defined as a set of connected pixels that create a bridge between two different regions. Edge detection is a method of segmenting an image into regions of conclusion. That's why we can say that the edge detection is also known as corner detection or shape detection. If edge is detected shape is also detected**.** Any points where image brightness changes sharply are typically organized into a line segments these termed knows edges. Similar problem of finding breaks in 1D signal is known as step detection and the problem of finding signal which are discontinue in nature over time is known as change detection in image processing.

DIFFERENT EDGES WITH DIFFERENT SHAPE:





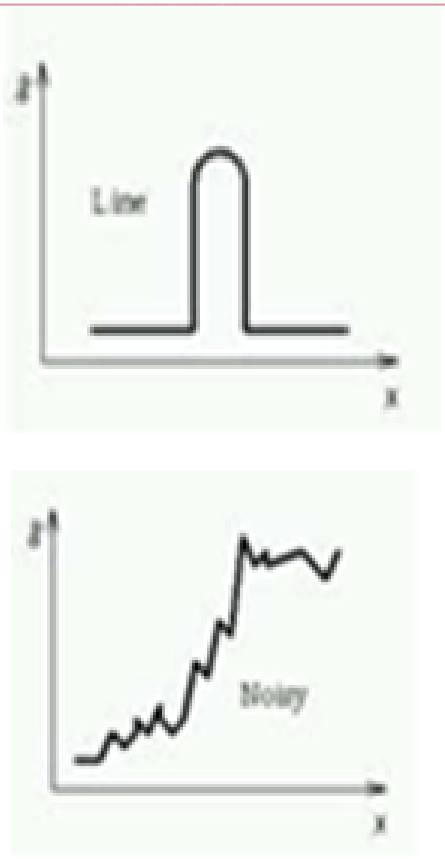


Fig. 1 Different Edge Profile

The changes in pixel intensity like brightness, contrast of the image describe the corners of objects in a picture. We know that the Feature extraction and Feature detection are the important term in the areas of image processing.

Digital image is made by a finite and different number of components, each pixel has a special place, position and most important value. These main components are cited to as image elements or picture elements, and also pixels. Image processing is the processing where any form of signal processing where image is as the input like a photograph and the output of the image processing may be also an image or a set of parameters which is associated to the image. In Digital image processing Edge defined as in binary images as the black pixels with neighbor white. Edges include large amount of important information about the image. Edge detection is very important and used in to extract and collect the information of image for example image enhancement and sharpening, location of object present in the image, their shape, size. Which depending upon variation of pixel intensity / grey level, various types of edges are shown in Different Edge profile in Figure 1.

II. Literature Survey

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.

Edge may be defined as a set of connected pixels that forms a boundary between two disarrange regions. Edge detection is a method of segmenting an image into regions of conclusion. Edge detection plays an very important role in digital image processing and practical aspects of our life. In this paper, we studied various edge detection techniques as Robert, Sobel and Canny operators. On comparing them we can see that canny edge detector performs better than all other edge detectors on various aspects such as it is flexible in nature, doing better for noisy image and gives sharp edges, low probability of detecting false edges etc.[1]

Hankyu Moon, Rama Chellappa, and Azriel Rosenfeld, propose an approach to accurately detecting two dimensional (2-D) shapes. The cross section of the shape boundary is modeled as a step function. We first derive a one-dimensional (1-D) optimal step edge operator, which minimizes both the noise power and the mean squared error between the input and the filter output. This operator is found to be the derivative of the double exponential (DODE) function, We define an operator for shape detection by extending the DODE filter along the shape's boundary contour. The responses are accumulated at the centroid of the operator to estimate the likelihood of the presence of the given shape. This method of detecting a shape is in fact a natural extension of the task of edge detection at the pixel level to the problem of global contour detection. This simple filtering scheme also provides a tool for a systematic analysis of edge-based shape detection. We investigate how the error is propagated by the shape geometry. We have found that, under general assumptions, the operator is

locally linear at the peak of the response. We compute the expected shape of the response and derive some of its statistical properties. This enables us to predict both its localization and detection performance and adjust its parameters according to imaging conditions and given performance specifications. Applications to the problem of vehicle detection in aerial images, human facial feature detection, and contour tracking in video are presented. [2].

Ali El-Zaart, Wafaa Kamel Al-Jibory explains Radar images have long been used in geological studies to map structural features that are revealed by the shape of the landscape. Radar imagery also has applications in vegetation and crop type mapping, landscape ecology, hydrology, and volcanology. Image processing is using for detecting for objects in radar images. Edge detection; which is a method of determining the discontinuities in gray level images; is a very important initial step in Image processing. Many classical edge detectors have been developed over time. Some of the well-known edge detection operators based on the first derivative of the image are Roberts, Prewitt, and Sobel, which is traditionally implemented by convolving the image with masks. In addition, Gaussian distribution has been used to build masks for the first and second derivative. However, this distribution has limit to only symmetric shape. This paper will use to construct the masks, the Weibull distribution which was more general than Gaussian because it has symmetric and asymmetric shape. The constructed masks are applied to images and we obtained good results. [3].

Sunanda Gupta ,Charu Gupta and S.K Gupta in their paper— Edge detection is important part of image processing for object detection. So it becomes extremely important to have a good understanding of edge detection algorithms. An edge is the real or imagined line that marks the limit and divides of plane, object or appearance from other places or things. This means that if the edges in an image can be identified accurately, all of the objects can be located and basic properties can be measured. This paper introduces a classification of most important and commonly used edge detection algorithms, namely Sobel, Robert, Prewitt, Laplacian of Gaussian, Canny, Ant colony Optimization [1].

III. Edge Detection Algorithm

We define image edge detection as the analysis of the real or imagined line that marks the limit and divides of image appearance from other places or things in a digital image.

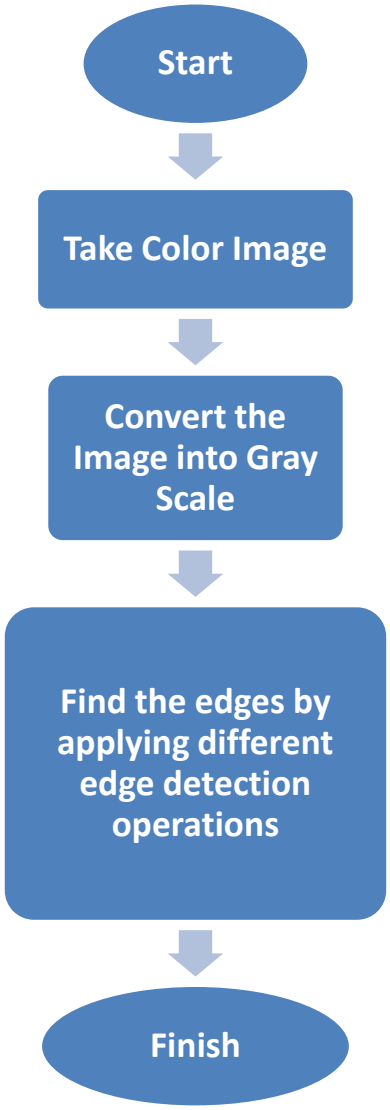


Fig. 2 Flow Chart of Edge Detection

It is a series of actions whose purpose is to recognize points in an image where clear and defined changes occur in the intensity. This action is necessary to realize the meaning of the content of an image and has its applications in the evaluation of image and machine vision. The end usage of discovering clear and defined changes in image intensity is to represent the bottom line events and changes in the

material properties of the world. Causes of Intensity alteration normally represent two types of events: one is geometric events and other is non-geometric events.

Step 1-Take a color image.

Step 2 -Smoothing: Annihilate as a noise as accessible, without wrecking genuine edges.

Step 3- Enhancement: the quality of edges is increased by applying differentiation.

Step 4- Threshold: Apply edge define magnitude threshold to determine which edge pixels should be retained and which should be discarded as noise.

Step 5- Localization: As certain the postulate the edge bearings.

Step 6- Evaluation with the algorithms.

Step 7- Get the detected image after edge disclosure.

One of the best technique for Edge detection is Canny Edge Detection so we will discuss on this.

3.1 Canny Edge Detector:

The Canny operator was designed to be an optimal edge detector (according to particular criteria, there are other detectors around that also claim to be optimal with respect to slightly different criteria). It takes input image a grey scale image and produces as output, an image showing the positions of captured intensity discontinuities.

How It Works

The Canny operator works great in a multi stage process. First, all the image is smoothed by Gaussian convolution. Then using a simple 2D first derivative operator like (somewhat like the Roberts Cross) is applied to the smoothed image to highlight regions of the image with high first spatial derivatives. According to the base paper, Edges gives rise to all ridges in the gradient magnitude image. The algorithm tracks along the top of these ridges and sets to zero all pixels that are not actually on the ridge top so as to give a thin line in the output this all process called as *non maximal suppression*. The tracking process shows hysteresis controlled by two thresholds: *T1* and *T2* with *T1* > *T2*. Chasing can only begin at a point on a ridge greater than *T1*. Chasing then continues in both directions out from that point until the height of the ridge falls under *T2*. This hysteresis helps a lot to ensure that noisy edges are not broken up into multiple edge fragments.

Fig: 3 Canny Edge Detector

Applications of Edge Detections in modern present era:

- In Biomedical Applications like Endoscopy, CT Scan, MRI Machines Etc.
- Detection of Aircraft in Radar.
- Concealed weapon Detection using X Ray Technology.

- Image Editing Tools or Software.
- 2D and 3D animations.
- Face Detection Technique using Sharp Edge Canny Detection
- Cable insulation layer measurement
- Edge detection of river regime
- In Automatic Multiple Faces Tracking System and Detection.

Major Advantage of canny edge detection algorithm

1. Less Sensitive to noise:

As compared to classical operators like Robert, Sobel and Prewitt canny edge detector is low sensitive to noise. By uses Gaussian filter which suppress noise at a great extent as compared to above filters. This LoG operator is very high sensitive to noise as differentiate twice in comparison to canny operator.

2. Remove and reduce streaking problem:

The classical operators' like Robert uses single thresholding technique but it results in the form of streaking. Streaking means if the edge gradient just above and just below the set threshold limit it removes the useful part of connected edge, and leave the disconnected the final last edge. To overcome from this type of drawback canny detector uses 'hysteresis' technique which uses two threshold values (T Low) and (T High) as discussed above in canny algorithm.

3. Adaptive in nature:

Classical operator has fixed kernels so cannot be adapted to a given image. The performance of the canny algorithm depends on variable or adjustable parameters like (Sigma) which is the standard deviation of Gaussian filter and threshold values (T low) and (T High). Smaller the value of (Sigma) results smaller Gaussian filter in turns results in fine edges. Therefore, user can changes these parameters and can improve the result of canny algorithm.

4. Good localization:

LoG operators cannot able to find edge orientation while canny operator provides edge gradient orientation, which results into good localization.

IV. CONCLUSION

In this paper, we discuss about edge detection techniques. We seen that canny edge detector gives better result as compared to others with have some positive clear points. It is very less sensitive to noise and resolved the problem of all streaking, line, sharp and provides good localization of process. This is optimal edge detection technique and lot of work and improvement to do on this algorithm and lots of improvements are possible in future as an improved canny algorithm can detect edges in color image without converting in gray image, improved canny algorithm for automatic extraction of moving object in the image guidance.

It finds practical application in Runway Detection and Tracking for Unmanned Aerial, Satellite Vehicle, Brain MRI image ,cable insulation layer measurement , Real-time facial expression recognition, edge detection of river regime, Automatic Multiple Faces Tracking and Detection. Canny edge detection technique is used in license plate reorganization system which is an important part of intelligent traffic system (ITS), it is useful in finds practical application in traffic management and military department. It also finds application in medical field as in ultrasound, x –rays etc. these are the main thing which works better in modern era.

The edge detector performance and algorithm of evaluation provides us a better understanding on possible ways of finding out the effectiveness of each developed detection models.

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