A Survey on various Edge Detection Techniques

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Abstract— Edge detection is one of the most commonly used methods in image analysis, and there are several algorithms available for detecting edges in to the images. The main purpose for this is that edges form the outline of an object. An edge is the border between an object and its background which indicates the border between the objects. So, if the edges in an image can be identified precisely, all of the objects can be located and basic properties such as area and shape can be measured. There are different edge detection techniques used to detection edges in image. In this paper, various edge detection techniques are surveyed as well as compared in order to figure out the most effective and accurate edge detection technique.
Key words: Image Enhancement, Image Processing, Edge, Edge Detection, Canny Edge Detection

I. INTRODUCTION

In the field of Image Processing, Edge is one of the fundamental characteristics of images, which has each and every sort of information of the image. Edge characteristics and properties are therefore very important in image processing, particularly, in the areas of feature detection and extraction [3]. To know the location of the edge of the image, the mutation points of the image signal must be found, which can give the whereabouts of the image profile. Digital image edge detection is that the digital image has a particular pattern of gray changes in position, segmentation, orientation and measurement of the images. The sole purpose of edge detection is to determine the unstable occurring and irregular structure and shape of the mutation point in the image, and then to provide the feature conditions that is needed for the image processing. Edge feature extraction is the important part in the image analysis and recognition, on which target detection and image segmentation depend [6].

The rest of the paper is structured as follows. Section II presents overview of edge detection. Section III presents literature survey. Section IV contains various edge detection techniques. Also comparison between various edge detection techniques as well as the conclusion at the end of the survey article.

II. OVERVIEW OF EDGE DETECTION

Edge detection is a process to determine the perimeter in an image. The edge is caused by the difference in brightness from one point to the others. If the brightness changes sharply, the edge is identified clearly [7]. For road lane detection, the result of applying an edge detector to an image should lead to a set of connected lines that indicate the road lane.
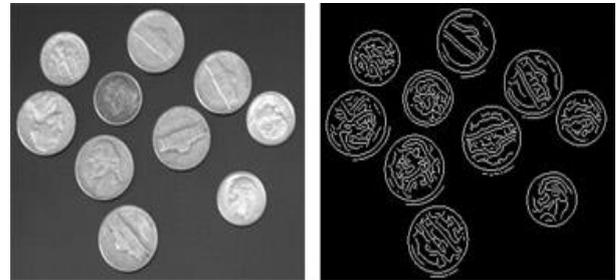

Fig. 1: Simple Edge Detection[9]

The edge detection techniques are mainly used to detect the different types of edges in the image. Edge detection process has a vast number of techniques, methods as well as algorithms through which the detection can be made within the image by converting the original image in to the grey scale image and then further applying a specific method or technique in order to extract or detect the edges in to the image.

There are different edge detection techniques such as Sobel Edge Detection, Prewitt Edge Detection, Roberts Edge Detection, Canny Edge Detection and many more. Also neural networks are referred to be used in order to detect the edges within the image but that remains the subject of more research for the contribution of neural networks to detect edges in the images.

In all there are many of the edge detection techniques which can be used in one or other ways for the purpose of the image extraction of edges in different ways. Every edge detection technique or algorithm has one or more advantages and limitations in terms of computation speed, noise handling [8], image thresholding and many other properties.

The quality of edge detection is highly dependent on lighting conditions, the presence of objects of similar intensities, density of edges in the scene, and noise [10]. While each of these problems can be handled by adjusting certain values in the edge detector and changing the threshold value for what is considered an edge, no good method has been determined for automatically setting these values, so they must be manually changed by an operator each time the detector is run with a different set of data.

III. LITERATURE SURVEY

In recent years, several techniques have been proposed to detect edges from roads as well as images. Various algorithms, techniques and methods are used to detect the edges.

A simple Robust Lane Detection Algorithm was proposed by Chan Yee Low, Hairi Zamzuri and Saiful Amri Mazlan [1]. In this paper, a road lane marker algorithm is presented in order to detect lanes i.e. left lane and the right lane. The algorithm uses the canny edge detection technique as well as the Hough Transform Technique. Here the system obtains road image with the help of sensor and then image

processing is applied to generate the road model. The canny edge detection and Hough transform are applied to detect the left and right lanes of road. Both the methods are used in order to detect lanes efficiently by using the road lane marker algorithm with the use of sensors.

In [2], Road Marking Detection for Vision based driver assistance system by Thota Sridevi, Shaik Rahamthulla and Joneboyina Pradeep. In this paper, a vision based driver assistance system is proposed which depends on the road lane and marker detection. An efficient algorithm is designed for road marking detection, tracking, and warning system for the vision based driver assistance system. This paper consists of different steps of the developed algorithm which are video grabbing, pre-processing, edge detection, Hough transform and post processing. The system only concentrates on the straight roads and not on the other shaped roads. The technique uses a vision based driver assistance system for the road markings effectively.

In [3] by Chung Lin Fan and Yuan yuan Ren, Study on the Edge Detection Algorithms of Road Image. In this paper, the analysis of various road edge detection algorithms is done. The comparison has been made of the road edge detection algorithms by comparing them with their simulation results. It is further concluded that each of the edge detection algorithm has a different functionality. Some algorithm has a better detection accuracy, and some algorithms have anti-noise performances. The thorough analysis of every algorithm is carried out in order to figure out which algorithm has a better performance and result.

Real-time lane detection for driving system using image processing based on edge detection and Hough transform [4] by Thittaporn Ganokratanaa., Mahasak Ketcham and Sasipa Sathienpong. In this paper, a real time detection for driving system using edge detection and Hough transform is defined. In this system, a method is proposed for detecting lane markers in real time by using webcam to record the road as video. Hough Transform method is used to detect the road lane markers for more accurate results for detecting road lanes. It can be concluded from the results after applying the image processing that the road marker detection can be made more accurate after modification of the same algorithm.

In [5], A Study of the Edge Detection for Road Lane by Worawit Phueakjeen, Nattha Jindapetch and Leang Kuburat. In this paper, an investigation is carried out in order to make sure which edge detection algorithm is efficient for the purpose of accurate road lane detection. The main issues, including the speed, the accuracy, and the limited resources, were taken to consider for the realization on the FPGA technology. In this paper, a number of road images are captured by a video camera. a mask filter was applied to remove red, green, and blue values to help the edge detection process be more efficient. The system can be made more accurate by modifying the techniques in order to get moreefficient results.

IV. VARIOUS EDGE DETECTION TECHNIQUES

Various Edge detection techniques can be categorized as following:

A. Canny Edge Detection Technique

Canny operator is a relatively new edge detection operator, which has been widely used. The basic idea of Canny operator is to make the image gradient operation, and then to obtain the edge by finding a local maximum gradient magnitude of pixels. In other words, the focus of the edge detection step is to find the actual image of the gradient which can be used for digital approximation [3]. Gradient is calculated by the derivative of Gaussian filter. Canny operator uses two thresholds to detect the strong edges and weak edges, and only if connected to the strong edges and the weak edges, the weak edges will be included in the output.

B. Sobel Edge Detection Technique

The Sobel algorithm is slower to compute than the other algorithms, but its larger convolution kernels smooth the input image to a greater extent and so makes the operator less sensitive to noise [5]. The Prewitt algorithm works in a very similar way to the Sobel algorithm but uses slightly different kernels.

C. Prewitt Edge Detection Technique

Prewitt operator is the first-order differential operator. It employs grey difference from top to bottom [3], left to right neighbouring pixels to get the extreme edge. The principle of Prewitt operator is similar to Sobel operator.
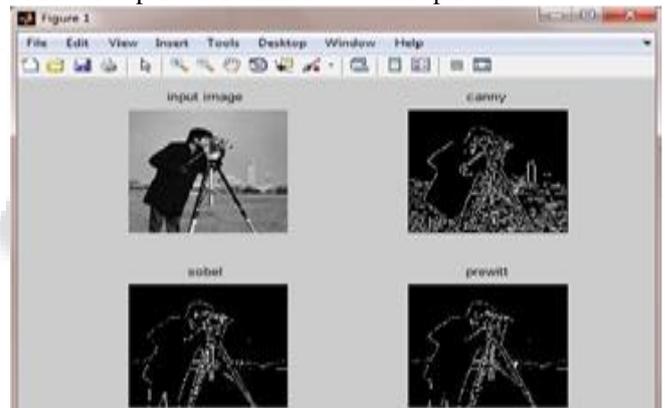

Fig. 1:

METHOD	PRINCIPLE	PROS	CONS
Sobel Edge Detection [3]	Partial differential operator to find the edge of image	Deals with the image having noise.	Results might be some blurred.
Prewitt Edge Detection [2]	First order differential operator and grey scale operator.	Can handle grey gradient as well as noisy image.	Computation speed is low and inaccurate.
Roberts Edge Detection [5]	Partial differential operator to find the edge of image	Deal with low noise image and rough image.	Not suitable as accuracy is low
Log based Edge	Second order	Can be used to	Seldom used as it is more

Detection [3]	differential operator and two pixel border.	determine edge in transparent area image.	sensitive to noise.
Canny Edge Detection [3]	Image gradient operation and local maximum gradient.	Most effective and accurate to detect edges in image.	Time Consuming.

Table 1: Comparative Analysis Of Various Edge Detection Methods

V. CONCLUSION

Image processing studies image to image transformation. The input and output both are images in image processing. In this paper, first the basics of the edge detection, then different types of edge detection techniques and methods are mentioned which appear in the images. Secondly, a survey of various edge detection techniques has been presented. In exiting methods have some limitation and some situation the edge detection is successfully detected. Different edge detection algorithms have been studied in order to figure out which of the edge detection algorithm is ideal to detect the edges in the image. The conclusion can be made that the Canny Edge Detection algorithm turns out to be the most accurate of other algorithms that are listed in the paper as it is more accurate and effective. This paper present is comparative analysis of different shadow detection methods for different types of images.

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