Certain Investigations on Various Edge Detection Algorithms In Real Time

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Abstract- *The developing technology of machine vision systems currently requires improved adaptive models and accurate image processing algorithms to incorporate various tasks such as preprocessing and recognizing objects in images. Edge detection which acts as a key technique in the field of image processing is used as the most fundamental tool. Edges are identified from an image when sudden change in the intensity level of adjacent image pixels. By detecting edges from the image, one can preserve its important structural features and eliminate unwanted information. In an image, to identify various edges, edge detection algorithms are used. The detection algorithms which can be used are Robert, Prewitt, Sobel and Canny. This project reviews all the above mentioned edge detection algorithms and gives a detailed comparative analysis. The simulation tool used is MATLAB-Simulink. Canny's technique is considered to be more optimal than other techniques in case of noise condition. Canny edge detector consists of multi stage algorithm which helps to detect wide edges in an image. Good detection, localization and only one response to single edge are the various performances.*

Keywords- Motion detection, Preset value, Body temperature, labour.

I. INTRODUCTION

Physical edges are the source of important visual information as they correspond to discontinuities in the geometrical, physical and photometrical properties of objects. The process of identifying and locating sharp discontinuities in an image is known as detection. The sudden change in an image intensity causes discontinuities which can identify boundaries of objects in a scene. Edge detection is nothing but finding sharp contrasts in intensities of an image. This significantly helps to reduce the amount of data in the image, while preserving the most important structural features of that image. The aspect detection and the aspect extraction from an image is possible by using edge detection. The main aim is to retrieve the application oriented structural edge pixels as highlighted as possible. It is necessary for delivering more necessary information with a high resolution. The main challenges while detecting edges from image are noise, data loss due to image format conversion and intrinsic precision error. The performance of the edge detection algorithm depends on the algorithm, type of image chosen to measure the performance, the parameters considered in the evaluation and the method used for evaluating edges.

II. EDGE DETECTION

The unexpected change occurs in the intensity value at the limit in the middle of two regions. The background portion or unwanted information has same or low intensity values which can be eliminated. The edge detection is applied in many fields such as Image recognition and segmentation, Image fusion, Image tracking, Face detection or human detection, Defense or security, Space Exploration, Surveillance, Authentic automated industry inspection. The classification of edge detection is given below,

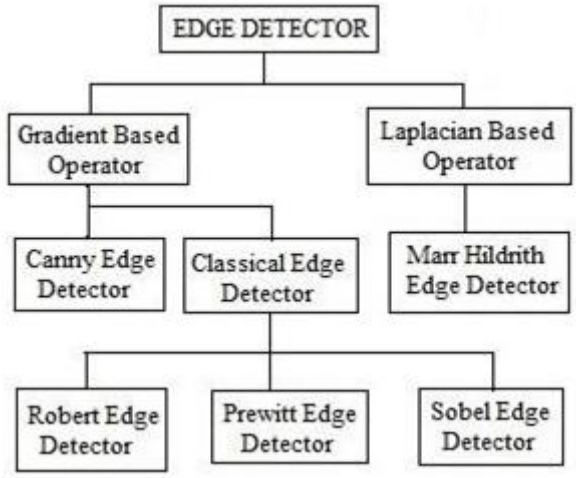

Fig.1 Classification of edge detection

A. Robert operator*:*

Robert operator includes some of the properties such as the background noise should be as low as possible ,the identified edge from an image should be well-defined, and intensity of identified edges should be more accurate to human's perception.

Robert operator uses two kernels to convolve with the original image. The original image is represented as *i(x,y)* where (x,y) are co-ordinates and value of function gives the intensity of the image at specific point of co-ordinate

P1	P2
P3	P4

Region of image

The robert operator masks are,

-1	0
0	1

Robert operator mask fx

0	-1
1	0

Robert operator mask fy

The first kernel convolved with the original image is gx and the second kernel convolved with the original image is gy.

The gradient is,
Magnitude, $mag(x,y) = \sqrt{gx^2+gy^2}$
The direction of gradient is,
Orientation, $\theta(x,y) = tan^{-1}(gy/gx)$
where, gx = change along x-Direction
gy = change along y-Direction

$gx = (p4 - p1)$
$gy = (p3 - p2)$

B. Sobel operator*:*

The Sobel operator is similar to that of the Prewitt operator. Compared with Prewitt, Sobel uses central difference for only one row.

P1	P2	P3
P4	P5	P6
P7	P8	P9

Region of image

-1	0	1
-2	0	2
1	0	1

Sobel operator mask fx

-1	-2	-1
0	0	0
1	2	1

Sobel operator mask fy

$gx = (p3 - p1) + 2(p6 - p4) + (p9 - p7$
$gy = (p7 - p1) + 2(p8 - p2) + (p9 - p3)$

C. Perwitt operator:

Prewitt operator uses the concept of central difference to calculate the maximum corresponding of the convolution kernels in series on the image to ensure the accuracy in locating edge.

P1	P2	P3
P4	P5	P6
P7	P8	P9

Region of image

3*3 kernels of horizontal and vertical is used in the perwitt operator.

-1	0	1
-1	0	1
-1	0	1

Perwitt operator mask fx

-1	0	1
-2	0	2
1	0	1

Perwitt operator mask fy

$$gx = (p3 - p1) + (p6 - p4) + (p9 - p7)$$
$$gy = (p7 - p1) + (p8 - p2) + (p9 - p3)$$

D. Canny algorithm*:*

Compared to the above mentioned edge detection algorithms, Canny edge detection is considered as an improved technique. The major advantage is low detecting rate and the location of the edge is well preserved. It also has the limited ability to check the possibility of existing multiple edge.It has additional blocks than classical operators and thus its hardware complexity is higher.

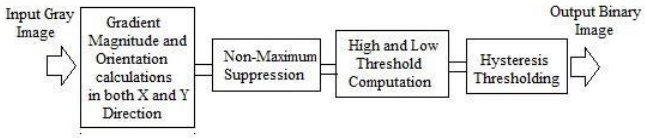

Fig.2 Block diagram of Canny algorithm

The steps followed in Canny edge detection is,

- Smoothening:
  To achieve smoothening in the image,Gaussian filter is used which removes noise present in the image.
- To find gradient magnitude and direction: Approximation methods are used to identify the large regions in image by finding gradient
- Non-Maximum Suppression:
  Strong edges are detected accurately and other edges are suppressed. It provides a thin edge line.
  If it is not surrounding the region, the peak value is 0.
- Hysteresis thresholding:
  Two thresholds are applied to eliminate streaking effect in the output display.

III. PROPOSED SYSTEM

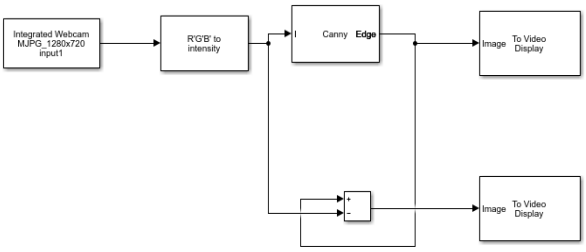

Fig.3 Block diagram of proposed system

Figure 3 shows the Simulink block diagram which opens a web camera and input image is acquired. Converts the RGB image to an "Intensity-only" image (Black and White), and performs four different edge detection algorithms Robert, Perwitt, Sobel, Canny. Using the Video Viewer block, the results of each algorithm is displayed on the screen individually.

IV. SIMULATION OUTPUT

Fig.4 Original image

Fig.5 Robert operator without feedback

Fig.6 Robert operator with feedback

Fig.7 Sobel operator without feedback

Fig.8 Sobel operator with feedback

Fig.9Perwitt operator without feedback

Fig.10 Perwitt operator with feedback

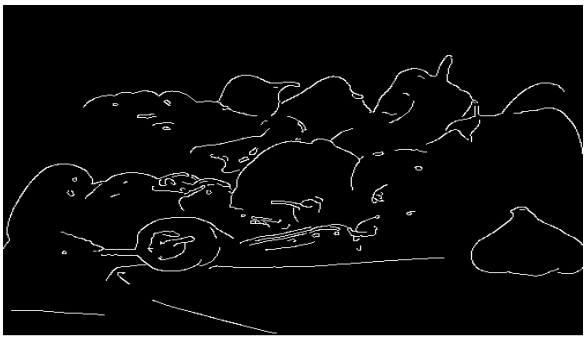

Fig.11 Canny operator without feedback

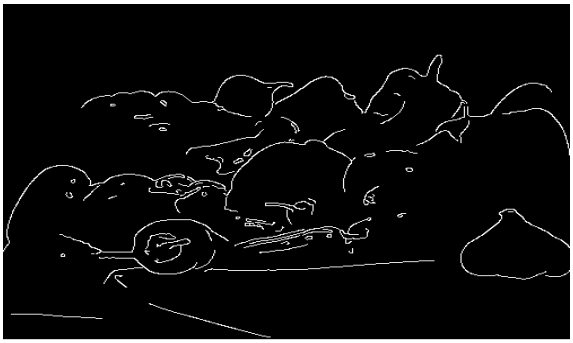

Fig.12 Canny operator with feedback

Fig.13 Canny operator with threshold value[0.5 0.15] without feedback

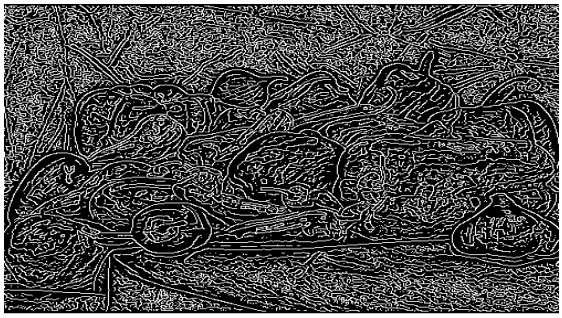

Fig.14 Canny operator with threshold value[0.5 0.15] with feedback

Fig.15 Original image

Fig.16 Robert edge detection

Fig.17 Sobel edge detection

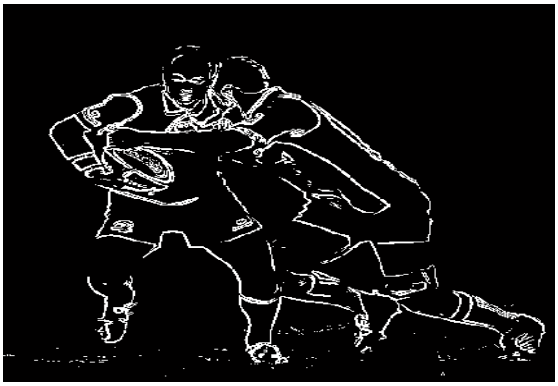

Fig.18 Perwitt edge detection

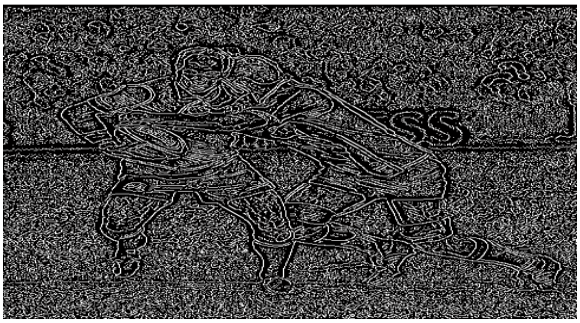

Fig.19 Canny edge detection

Fig.20 Canny edge detection with threshold value

Edge detection	Merits	Demerits
Robert, Prewitt, Sobel(Classical operator)	1.Simple 2.To detect edges with their orientations	1.Inaccuracy 2.Sensitive to noise
Gaussian(Canny)	1.To find error rate using probability. 2.Signal to noise ratio is improved 3.Improved detection in noise conditions	1.Consume more time 2.Zero crossing is not accurate 3.Complex calculations

V. CONCLUSION

Classical operators such as Robert, Perwitt and Sobel operator lack accuracy. The major drawback is sensitivity to noise, kernel size and coeffecients remains unchanged to corresponding images as they are fixed constantly. Canny algorithm has improved accuracy and can be used in various applications. The computations of Canny algorithm is more complex but has improved results in case of noise condition. The quality of output in Canny is based on the threshold values. Implementing this algorithm for the images in the medical fields and real time industrial applications can be more effective. Further, a detailed study can be done by comparing different threshold values and its results on various images.

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