Simulink Model Based Image Segmentation

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Abstract : This Paper presents an efficient architecture for Image Segmentation. This architecture offers an alternative through a Graphical User Interface tool MATLAB. Image segmentation can be obtained by using various methods, but the drawback of most of the methods is that they use a high level language for coding. This paper focuses on processing an image pixel by pixel and in modification of pixel neighbourhoods that can be applied to the whole image. The objective lead to the use of a tool with a high-level graphical interface under the Matlab Simulink based blocks which makes it very easy to handle with respect to other software. The various applications where noise removal, enhancing edges and contours, blurring and so on. This paper presents the architecture of filtering images for edge detection with the help of Video and Image Processing blockset.

Keywords: Image Segmentation, Edge detection,MATLAB, Simulink Model, GUI

I. INTRODUCTION

In computer vision, image processing is any form of signal processing for which the input is an image, such as photographs or frames of videos. The output of image processing can be either an image or a set of characteristics or parameters related to image. The image processing techniques like image restoration, image enhancement, image segmentation etc. The Image Segmentation refers to the process of partitioning an image into multiple segments based on selected image features (sets of pixels). Segmentation subdivides an image into its constituent regions or objects. The level to which the subdivision is carried depends on the problem being solved. That is, segmentation should stop when the objects of interest have been isolated. The goal of segmentation is to simplify and change the representation of an image into something that is more meaningful and easier to analyse. Image segmentation is typically used to locate objects and boundaries in images. More precisely, it is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics. For example, in the automated inspection interest lies in analysing images of the products with the objective of determining the presence or absence of specific anomalies, such as missing components or broken connection paths. The partitions and different objects in image segmentation is a set of regions that collectively cover the entire image. All of the pixels in a region are similar with respect to some characteristic or computed property such as colour, intensity, or texture. Some practical applications of image segmentation are: Image processing, computer vision , Face recognition, Medical Imaging, Digital libraries, Image and Video retrieval. Image segmentation methods fall into four categories:-
1) Point Based Segmentation,   2) Edge Based Segmentation, 3) Line Based Segmentation, 4) Region growing Based segmentation. The drawbacks of most of the methods are that they use a high level language for coding. This paper focuses on processing an image pixel by pixel and in modification of pixel neighbourhoods that can be applied to the whole image. The objective lead to the use of a tool with a high-level graphical interface under the Matlab Simulink based blocks which makes it very easy to handle with respect to other software. The various applications where noise removal, enhancing edges and contours, blurring and so on. This paper presents the architecture of filtering images for edge detection with the help of Video and Image Processing blockset.

II. IMAGE SEGMENTATION

The first step in image analysis is segment the image. Segmentation subdivides an image into its constituent parts or objects. The level to which this subdivision is carried depends on the problem being viewed. Sometime need to segment the object from the background to read the image correctly and identify the content of the image for this reason there are two techniques of segmentation, discontinuity detection technique and similarity detection technique. In the first technique, one approach is to partition an image based on abrupt changes in gray-level image. The second technique is based on the threshold and regiongrowing. This paper discusses the first techniques using Edge Detection method based on Simulink Model.

III. DISCONTINUITY DETECTION

Discontinuity detection is partition an image based on abrupt changes in gray-level image by using three types of detection:

A. Point Detection

The detection of isolated points in an image is straight forward by using the following mask; we can say that a point has been detected at the location on which the mask is centered, if:

$|R|>T$

Where T is the threshold and
R = - (x1+x2+ x3+ x4+ x5+ x6+ x7+ x8+ x9)+8*x5
xi is an image pixel.

-1	-1	-1
-1	8	-1
-1	-1	-1

Figure shows point detection mask

B. Line Detection

Line detection is an important step in Image processing and analysis. Lines and edges are features in any scene from simple indoor scene to noisy terrain images taken by satellite. If the algorithm to detect these features is not properly designed then we have to introduce the intermediate step of line/edge completion in between feature extraction and interpretation, which serves to join the disrupted segments.The next level of complexity involves the detection of lines in an image. Consider the following masks:

-1	-1	-1
2	2	2
-1	-1	-1

Figure shows line detection Horizontal mask

If this mask were moved around an image, it would respond more strongly to line (one pixel thick) oriented horizontally. With constant background, the maximum response would result when the line passed through the middle row of the mask.

C. Edge Detection

Edge detection is one of the most commonly used operation in image analysis, and there are probably more techniques for image enhance and detecting edges. An edge is a boundary between two regions with relatively distinct gray-level properties. In the following discussion, the assumption is that the region in questions are sufficiently homogenous so that the transition between two regions can be determined on the basis of gray-level discontinuities alone. Such discontinuities are detected by using:-
1. First-Order derivative, and
2. Second-order derivative.

- **First-order derivative**:- The First-order derivative of choice in Image processing is the Gradient of a 2-D function. The Gradient of a 2-D function f(x,y), is defined as the vector.

$$\nabla f = \begin{matrix} g_x \\ g_y \end{matrix} = \begin{matrix} \frac{\partial f}{\partial x} \\ \frac{\partial f}{\partial y} \end{matrix} \qquad (1.1)$$

The Gradient of this vector is

$$\nabla f = mag(\nabla f) = [g_x^2 + g_y^2]^{1/2}$$

To simplify computation, this quantity is approximated sometimes by omitting the square-root operation,

$$\nabla f = g_x^2 + g_y^2 \quad (1.2)$$

A fundamental property of the gradient vector is that it points in the direction of the maximum rate of change of f at coordinates (x,y). The angle at which this maximum rate of change occurs is:

$$\propto (x,y) = \tan^{-1} g_x/g_y \quad (1.3)$$

- **Second-order derivative**:- in image processing generally are computed using the Laplacian of a 2-D function f(x,y) is formed from second-order derivatives:

$$\nabla^2 f(x,y) = \frac{df}{dx} + \frac{df}{dy} \qquad (1.4)$$

The basic idea behind edge detection is to find places in an image where intensity changes rapidly, using one of two general criteria:
1. Find places where the first derivative of the intensity is greater in magnitude than a specified threshold.
2. Find places where the second derivative of the intensity has a zero crossing. The Edge Detection include various techniques such as
   - Sobel Edge Detection
   - Canny Edge Detecteion
   - Roberts Edge Detection

IV. PROPOSED MODEL FOR IMAGE SEGMENTATION

The entire process of Image segmentation goes through three phases which are explained as below:
- Image Pre-processing blocks.
- Edge Detection using Sobel detector
- Image Post-processing blocks.

Image Pre-processing Blocksets:
The model based design used for image pre-processing is shown in Fig. 1, the blocks utilized here are discussed below. Input images which could be colour or gray scale are provided as input to the workspace block. A colour space conversion block converts RGB to gray scale image and this data which is in 2D is to be converted to 1D for further processing. Image Video viewer block at output signal to show the converted image(RGB to gray scale).
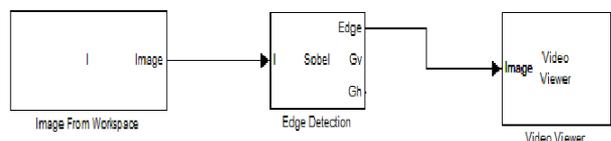

Fig 1 shows block diagram for Image pre-processing

Edge Detection using Sobel edge detector:
The model based design using sobel edge detector for processing the inpu image for detection is shown in Fig. 2,
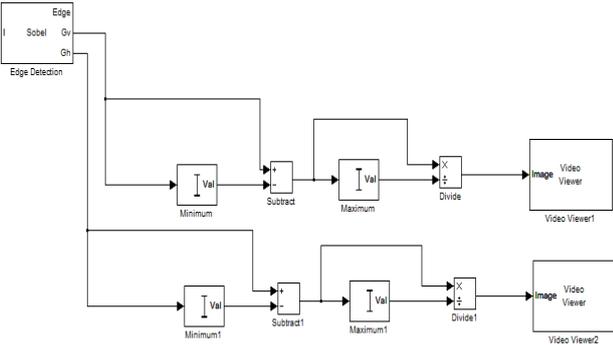

Fig. 2 shows block diagram for Edge detection using Sobel Edge Detector

Image Post-Processing:
The image post-processing blocks which are used to convert the image back to floating point type as shown in Fig. 3,
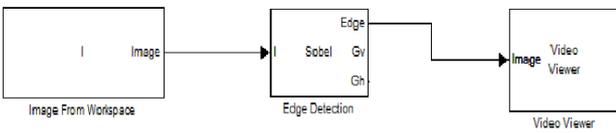

Fig. 3 shows Image post processing block diagram
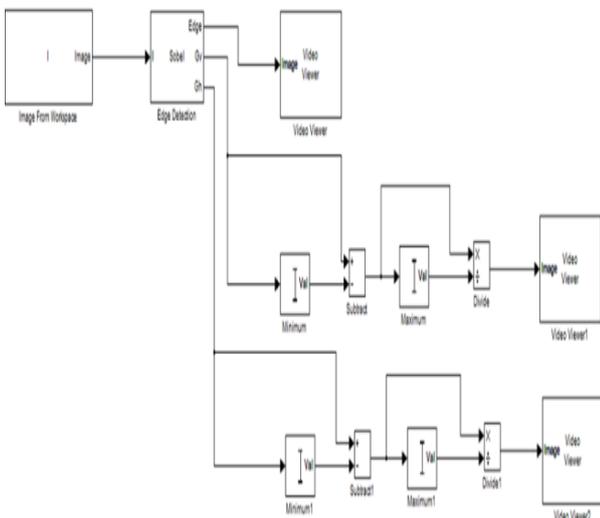
SIMULINK MODEL FOR SEGMENTATION:-

Fig. 4 shows Simulink Model for Image Segmentation

V.   RESULTS:
The different edge detection operators implemented in this paper are given below along with their software implementation. The input image utilized for edge detection and outputs of various operators is shown in fig. 5.

Fig.5(a) shows input image

Fig.5(b) shows output image

VI.   CONCLUSION
The Simulink Model based Image Segmentation is a new application in image processing and offers a model based design for processing. The filters are designed by blocks and it even support Matlab codes through user customizable blocks. It also offers an ease of designing with GUI environment. This tool supports software simulation which is important to avoid high level language for coding. These features are essential in real time image processing. The design architecture used in this paper for also supports, counting number of spokes and cells (human body cells) which is an important application for Bio-Medical Science. The Image segmentation of noisy fingerprint(Fig.5(c)) is the method which has been successfully used in all biometric techniques.

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