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Development Of Edge Detection Algorithms For Video Frames Using Rgb-Yuv Colour Modelsin Matlab

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Abstract: -- **An edge is a place of rapid change in the image intensity function. Edges are caused by a variety of factors. Image edge detection is an integral component of image processing to enhance the clarity of edges and the type of edges. Edge detection is the process of localizing pixel intensity transitions. The edge detection has been used by object recognition, target tracking, segmentation etc., Therefore, the edge detection is one of the most important parts of image processing. The purpose of edge detection is to discover the information about the shapes and the reflectance or transmittance in an image. It is one of the fundamental steps in image processing, image analysis, image pattern recognition, and computer vision, as well as in human vision. Edges of an image are considered a type of crucial information that can be extracted by applying detectors with different methodology. This paper presents a comparative study on different approaches to edge detection of video frames. These approaches are based on transforming the RGB frame to YUV model. Video frame edges are detected by using edge detector operator called Laplacian operator. This paper provides a deeper analysis regarding video frame edge detection by constructing video input object, selecting source for video acquisition, previewing a stream of image frames, capturing sequence of video frames from live video stream, matrices, partial derivatives and convolutions by using MatLab.**

Keywords: **Colour Models, Edge detection, Laplacian Operator, Sobel Operator.**

I. INTRODUCTION

Edges are significant local intensity changes in the image and are important features to analyze an image. They are important clues to separate regions within an object or to identify changes in illumination or colour. They are an important feature in the early vision stages in the human eye. Edge detectionidentifies sudden changes (discontinuities) in an image. Primary goal is to extract information about the two-dimensional projection of a 3D scene.Secondary goal is Image segmentation, region separation, objects description and recognition etc.

Edge Point is one in an image with coordinates [I, j] at the location of a significant local intensity change in the image.Edge fragment is a small line segment about the size of a pixel, or as a point with an orientation attributes. The term edge is commonly used either for edge points or edge fragments. Edge detectoris algorithm that produces a set of edges (edge points or edge fragments) from an image. Some edge detectors can also produce a direction that is the predominant tangent direction of the arc that passes through the pixel. Contour is list of edges of the mathematical curve that models the list of edges. Edge Origins of edges are 1.Surface normal discontinuity 2.Depth discontinuity 3. Surface color discontinuity 4.Illumination discontinuity [1]. Using Edgedetection important features can be extracted from the edges of animage (e.g., corners, lines, curves).These features are used by higher-level computer vision algorithms (e.g., recognition).The optimal detector should find all real edges, ignoring noise or other artifacts. The edges detected must be as close as possible to the true edges. The detector must return one point only for each true edge point.Cues of edge detection are differences in color, intensity, or texture across the boundary and continuity and closure.

II. DIFFERENT COLOUR MODELS:

A color model is an abstract mathematical model describing the way colors can be represented as tuples of numbers, typically as three or four values or color components. To utilize color as a visual cue in multimedia, image processing, graphics and computer vision applications, an appropriate method for representing the color signal is needed. The different color specification systems or color models address this need. Color spaces provide a rational method to specify order, manipulate and effectively display the object colors taken into consideration. Thus

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the selected color model should be well suited to address the problem's statement and solution. The process of selecting the best color representation involves knowing how color signals are generated and what information is needs from these signals.. In particular, the color models may be used to define colors, discriminate between colors, judge similarity between colors and indentify color categories for a number of applications.

A. *The RGB Model:*

The RGB color model is an additive color model in which red, green and blue are added together in various ways to reproduce a broad array of colors. The name of the model comes from the initials of the three additive primary colors, red, green and blue. In the RGB model, an image consists of three independent image planes, one in each of the primary colours: Red, Green and Blue. Specifying a particular colour is by specifying the amount of each of the primary components present. Figure 1 shows the geometry of the RGB colour model for specifying colours using a Cartesian coordinate system. The greyscale spectrum, i.e. those colours made from equal amounts of each primary, lies on the line joining the black and white vertices. The RGB model is used for colour monitors and most video cameras.RGB (red, green, and blue) refers to a system for representing the colors to be used on a computer display. Red, green, and blue can be combined in various proportions to obtain any color in the visible spectrum. Levels of R, G, and B can each range from 0 to 100 percent of full intensity [2], [3].

A color's RGB value indicates its red, green, and blue intensity. Each intensity value is on a scale of 0 to 255, or in hexadecimal from 00 to FF [2], [3].

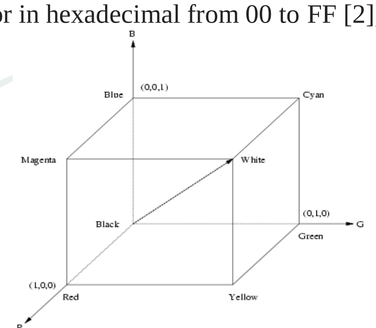

Figure1: The RGB colour cube. The grey scale spectrum lies on the line joining the black and white vertices.

B. *YUV Colour Model:*

YUV is a color space typically used as part of a color image pipeline. It encodes a color image or video taking human perception into account, allowing reduced bandwidth for chrominance components, thereby typically enabling transmission errors or compression artifacts to be more efficiently masked by the human perception than using a "direct" RGB-representation. The Y′UV model defines a color space in terms of one luma (Y′) and two chrominance (UV) components. Y′ stands for the luma component (the brightness) and U and V are the chrominance (color) components; luminance is denoted by Y and luma by Y′ – the prime symbols (') denote gamma compression,[1] with "luminance" meaning perceptual (color science) brightness, while "luma" is electronic (voltage of display) brightness.

YUV is a file extension for a raster graphics file often associated with the Color Space Pixel Format [4], [5]. YUV files contain bitmap image data stored in the YUV format, which splits color across Y, U, and V values; stores the brightness (luminance) as the Y value, and the color (chrominance) as U and V values.

The Y component determines the brightness of the color (referred to as luminance or luma), while the U and V components determine the color itself (the chroma). Y ranges from 0 to 1 (or 0 to 255 in digital formats), while U and V range from -0.5 to 0.5 (or -128 to 127 in signed digital form, or 0 to 255 in unsigned form). Some standards further limit the ranges so the out-of-bounds values indicate special information like synchronization.

III. CONVERSION BETWEEN RGB - YUV

$$R = Y + 1.4075 * (V - 128)$$
$$G = Y - 0.3455 * (U - 128) - (0.7169 * (V - 128))$$
$$B = Y + 1.7790 * (U - 128)$$

$$Y = R * 0.2990 + G * 0.5870 + B * 0.1140$$
$$U = R * -0.1687 + G * -0.3312 + B * 0.5000 + 128$$
$$V = R * 0.5000 + G * -0.4186 + B * -0.0813 + 128$$

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IV. STEPS OF PROPOSED METHOD

The proposed method consists of four steps. At first, the image is smoothed by median filter to suppress unwanted noise in the image. Secondly, maximum directional differences of sum of gray values (Red+Green+Blue) are calculated for each pixel. In the third step, image is thresholded with a single threshold value and finally the detected edges are thinned to get the proper edge map.

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VIII. EDGE DETECTION OPERATORS

A. Laplacian Operator:

Laplacian Operator is also a derivative operator which is used to find edges in an image. The major difference between Laplacian and other operators like Prewitt, Sobel, Robinson and Kirsch is that these all are first order derivative masks but Laplacian is a second order derivative mask. In this mask we have two further classifications one is Positive Laplacian Operator and other is Negative Laplacian Operator.Another difference between Laplacian and other operators is that unlike other operators Laplacian didn't take out edges in any particular direction but it take out edges as Inward Edgesand OutwardEdges [6].

Positive Laplacian Operator:

In Positive Laplacian we have standard mask in which center element of the mask should be negative and corner elements of mask should be zero. Positive Laplacian Operator is use to take out outward edges in an image.

Negative Laplacian Operator:

In negative Laplacian operator we also have a standard mask, in which center element should be positive. All the elements in the corner should be zero and rest of all the elements in the mask should be -1.

0	1	0
1	-4	1
0	1	0

0	-1	0
-1	4	-1
0	-1	0

Positive LaplacianNegative Laplacian

Negative Laplacian operator is used to take out inward edges in an image.Laplacian is a derivative operator. Its uses highlight gray level discontinuities in an image and try to deemphasize regions with slowly varying gray levels. This operation in result produces such images which have grayish edge lines and other discontinuities on a dark background. This produces inward and outward edges in an image.The important thing is how to apply these filters onto image. We can't apply both the positive and negative Laplacian operators on the same image. We have to apply just one but the thing to remember is that if we apply positive Laplacian operator on the image then we

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subtract the resultant image from the original image to get the sharpened image. Similarly if we apply negative Laplacian operator then we have to add the resultant image onto original image to get the sharpened image [7], [8].

B. SOBEL OPERATOR

The operator consists of a pair of 3 X 3 convolution kernels as shown in Figure1.1. The Figure 1.1a represents 3 X 3 mask along x-axis and Figure.1.1b represents 3 X 3 mask along y-axis[7],[8].

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

Figure2.1a

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

Figure 2.1b

Figure 2: 3 X 3 sobel convolution kernels

These kernels are designed to respond maximally to edges running vertically and horizontally relative to the pixel grid, one kernel for each of the two perpendicular orientations. The kernels can be applied separately to the input image to produce separate measurements of the gradient component in each orientation. These kernels can be combined together to find absolute magnitude of the gradient at each point and the orientation of that gradient [9].

EXPLANATION:

1) Read the image
2) Convert the image to double
3) Use the mask F1 for x direction and F2 for y direction and obtain the gradient of the image.
4) Find the magnitude of the vector.
5) Since we need 3x3 image pixels, the border pixels are not considered, and so starting from the pixel (2, 2) theedgedetection process starts.
6) Threshold the image
7) Display the logical image

Advantages of Sobel operator are it performs better noise suppression and Image smoothing. Disadvantage is Diagonal direction points are not preserved always.

FLOW CHART

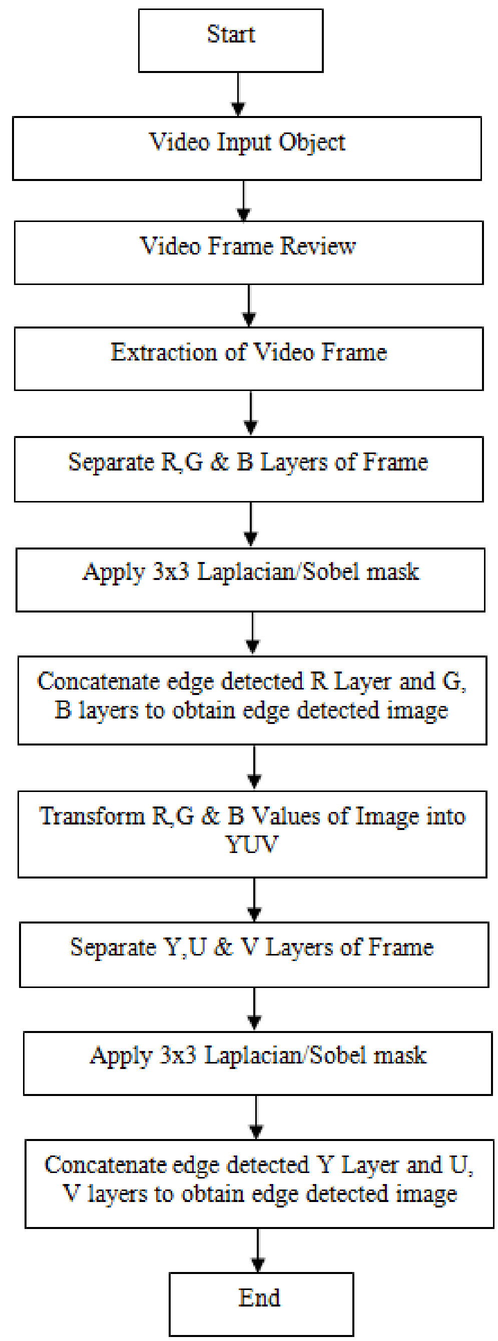

Fig.3. Flowchart of Video Frame edge detection

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IX. VIDEO FRAME EDGE DETECTION ALGORITHM:

The Proposed algorithm using Laplacian Operator can be explained by the following steps

1. Constructing a Video Input Object
2. Preview a stream of image frame
3. Extraction of Image Frame
4. Video Frame is subdivided into R G B Layers
5. 3 X 3 Laplacian mask is convolved with the R component
6. Edge detected R and the G,B layers of an image are concatenated to obtain edge detected frame.
7. R, G and B values of the frames are transformed into its YUV values using conversion formula.
8. 3 X 3 Laplacian mask is convolved with the Y component of video frame.
9. Edge detected Y and U, V layers of video frame are concatenated to obtain edge detected frame.

The Proposed algorithm using Sobel Operator can be explained by the following steps

1. Constructing a Video Input Object
2. Preview a stream of image frame
3. Extraction of Image Frame
4. Video Frame is subdivided into R G B Layers
5. Sobel mask is convolved with the R component
6. Edge detected R and the G, B layers of an image are concatenated to obtain edge detected frame.
7. R, G and B values of the frames are transformed into its YUV values using conversion formula.
8. Sobel mask is convolved with the Y component of video frame.
9. Edge detected Y and U, V layers of video frame are concatenated to obtain edge detected frame.

X. EXPERIMENTAL RESULTS

Laplacian Operator and Sobel operators are used to detect edges on video frame fig.4.1 to fig 4.11 are the RGB layers of the image and Laplacian edge detected images, Laplacian YUV edge detected frames.


Fig.4.1

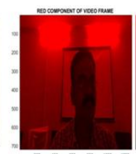
Fig.4.2

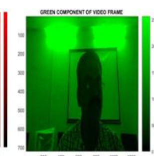
Fig.4.3

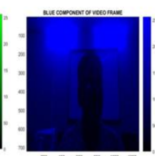
Fig.4.4

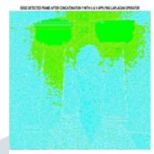
Fig.4.5

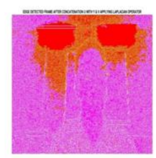
Fig.4.6

Fig.4.7


Fig.4.8


Fig.4.9


Fig.4.10

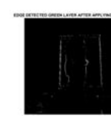
Fig.4.11

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