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Optimization of Feature Extraction Algorithm for License Plate of Vehicle, Detection Using Histogram Method

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Abstract— Image segmentation is a very important step in image processing. Extracting useful information from an image is the goal of image segmentation. The purpose of image segmentation is to partition an image into meaningful regions with respect to a particular application. *Local image* information is crucial for accurate segmentation of images with intensity in homogeneity. *A* region-based active contour model *that is* able to utilize image information in local regions. The major contribution of Local Binary Fitting Model is the introduction of a local binary fitting energy with a kernel function, which LBF enables the extraction of accurate local image information. Therefore LBF can be used to segment images with intensity in homogeneity, which overcomes the limitation of piecewise constant models.

The active contour/snake model is one of the most successful variation models in image segmentation. It consists of evolving a contour in images toward the boundaries of objects. A global minimum of the active contour model approach is based on the unification of image segmentation and image denoising tasks into a global minimization framework. Image segmentation is an important application of image processing. In Extraction Algorithm achieved the segmentation and extraction of symbols using minimum spanning tree based segmentation method. The presents the extraction of symbols and characters from document images and describes the number of symbols extracted from the images. Symbols itself include all characters and characters includes all the letters and numbers. The focus is on the black and white images. Basically this is achieved by using image segmentation in color domain. That is why each and every symbol or character in document images should be disjoint. The algorithm also extracts the handwritten symbols and characters from binary images.

***Index Terms*—Image Segmentation, License Plate Reorganization, Sobel Operator, Wavelet Transform.**

I. INTRODUCTION

Digital Image Processing consists of several steps. The first step is image acquisition i.e., to acquire a digital image. After a digital image has been obtained the next step deals with pre-processing that image. The key function of pre-processing is to improve the image in way that increases the chances for success of the other processes. The next stage deals with image segmentation. The goal of image segmentation is to cluster pixels into salient image regions, i.e., regions corresponding to individual surfaces, objects, or natural parts of objects. Image segmentation partitions an input image into its constituent parts or objects. The field of digital image processing refers to processing of digital images by means of digital computer.Various digital image processing Methods is based on measurements taken from the image i.e. grey level or colour intensity, texture information, depth or motion of object. In computer vision, segmentation is the process of partitioning a digital image into multiple segments (Sets pixels, also known as super pixels). The goal of segmentation is to simplify and change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is used to locate objects and boundaries (lines, curves, etc.) in images. Vehicles in each country have a unique license number, which is written on its license plate. This number distinguishes one vehicle from the other, which is useful especially when both are of same make and model. An automated system can be implemented to identify the license plate of a vehicle and extract the characters from the region containing a license plate. The license plate number can be used to retrieve more information about the vehicle and its owner, which can be used for further processing. Such an automated system should be small in size, portable and be able to process data at sufficient rate.

In this approach, initial image processing and binarization of an image is carried out based on the contrast between characters and background in license plate. After binarizing the image, it is divided into different black and white regions. These regions are passed through elimination stage to get the final region having most probability of containing a number plate.

II. AN EFFICIENT SKEW DETECTION OF LICENSE PLATE IMAGES BASED ON WAVELET TRANSFORM

A. Introduction

Some geometric distortion of vehicle license plate images is caused by the perspective effect of lens. The front of a VLP is a function of the position vector of the license plate with respect to the camera lens. As shown in fig.1, geometry of camera - VLP interaction, two points that are near from the centre of camera appear more distant in the image than the same two points when they are far from the centre of the camera. It is almost impossible to take an undistorted license plate from moving vehicle. The ideal license plate is a rectangle but the skewed VLP can be approximated as a

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parallelogram. According to the prior knowledge, there are three kind of tilts are possible: horizontal tilt, vertical tilt, and combination of both horizontal and vertical tilt. VLP has both the types of horizontal and vertical tilt together as shown in fig. 2.2.

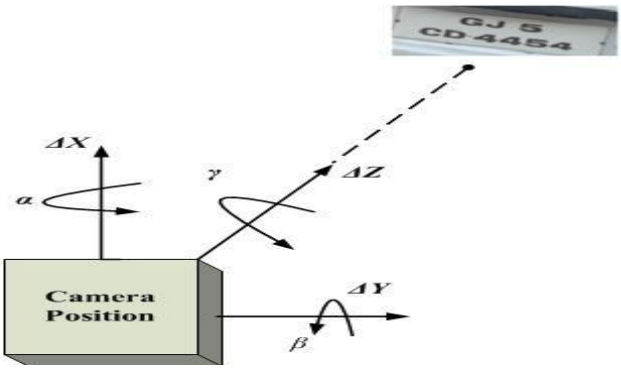


Figure: 1 the geometry of camera-VLP interaction Page Layout

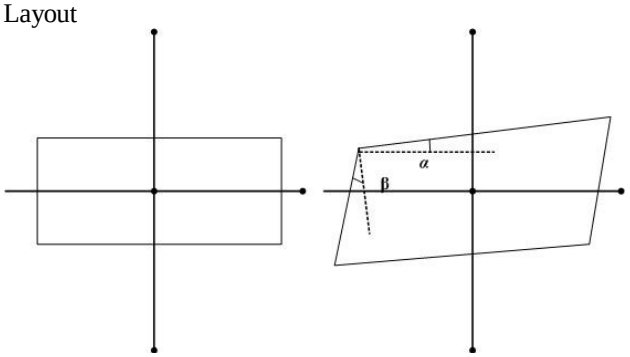


Figure: 2(a) un skewed plate (b) Plate with horizontal and vertical skew

B. Skew Detection Method

The proposed algorithm is based on wavelet transformation and principal component analysis as shown in fig. 3.

1. If the input image is not a grey one, transform it in to grey scale image
2. By decomposing image with 2D-DWT, four frequency sub bands LL1, LH1, HL1 and HH1 are obtained. Again by taking second level of decomposition we have achieved bands LL2, LH2, HL2 and HH2.

Here, the using LH1, HL1, LH2 and HL2, as it preserves horizontal and vertical details contained in the image, as well as we get good approximation of the results.

3. Set a threshold value to binaries the levels obtained after wavelet analysis. White pixels in the image are the extracted feature points. Measurement of the two variables x1 and x2 are considered and measured data under consideration is within the coordinate system (x1|x2), and then the transform it into new coordinate system (z1| z2). The new set of values is examined; the direction in which data are maximal is the direction of principal component z1 and the one with smaller variations is z2. Therefore the component with the smaller variations is neglected.
4. In first level after finding Eigen values λ 1 and λ 2 arrange it in descending order and find corresponding Eigen vector P1 and P2 for LH1 and finally rotation angle ϴLH1 will be obtained.
5. Repeat similar procedure for all.
6. Take mean of all four angles and rotate the figure with same. Now rotation of the skewed image can be achieved using any of the following methods: (a) Nearest neighborhood interpolation, (b) Bicubic interpolation, (c) Bilinear interpolation.

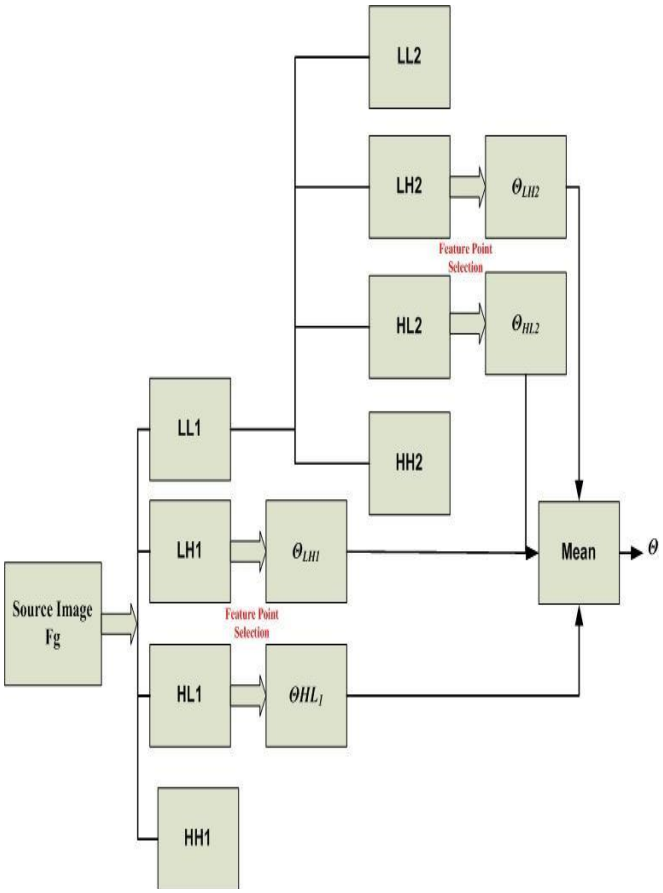
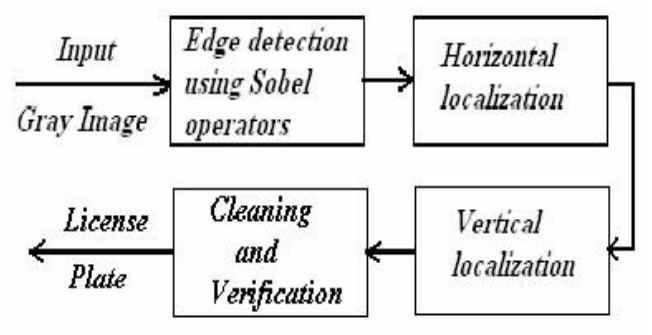


Figure: 3 Representation of skew detection method

III. PLATE DETECTION

Indian license plate consist of a row of white characters on a black background, so we can say that the license plate region is characterized by a row of transitions from black to white and vice versa, such transition are called “edges”. The total change in intensity from plate’s characters to its background is called the strength of the edge. The strongest edge value that can occur can be found in the case of a transition from a black pixel to a white pixel or from a white pixel to a black pixel. This is the ideal case in Indian license plate where the characters are white drawn on black background, and hence they produce high intensity edge values which can be used to find possible plate regions. We are going to use Sobel operators to find the edge image. The Sobel Operator performs a 2-D Spatial gradient measurement on an image. Typically it is used to find the approximate absolute gradient magnitude at each point in an input gray scale image. The Sobel edge detector uses a pair of

3x3 convolution masks, one estimating the gradient in the x-direction (columns) and the other estimating the gradient in the y-direction (rows). The actual Sobel masks are shown



in fig. 4

Fig: 4 Plat extraction modules.

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

(a)

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

(b)

Fig: 5 Sobel masks for edge detection, (a) Vertical (b) Horizontal

Fig. 5 illustrates an edge detection process using Sobel operator. The lighter region indicates stronger edges as the case for license plate.

After creating the edge image the system will search for region with high edge value which is most likely to contain a license plate. To do so, the system will construct a horizontal projection profile for the edge image. A projection profile of an image is a compact representation of the spatial pixel content distribution. A horizontal projection profile is defined as the vector of the sums of the pixel intensities over each row.

The algorithm starts by sliding a window through each horizontal segment and sums the values of edges inside the window's area to get the average gradient magnitude per pixel inside the window at that specific location. For each horizontal segment, the algorithm will store the later processing; we shall call this vector an HDV and can be calculated as:

Where, i= 0,1….(ImW-M+1),G(x,y) is the edge image, W is the sliding window ,Aw is the area of the sliding window. ImW is the width of the image and M is the width of the sliding window.HDV is horizontal Density Vector.

Fig. 6 illustrates the computation process of the horizontal Density Vector (HDV) graph increase gradually until it reaches the peak of the graph and then decreases again, at the peak point in the HDV graph the sliding window aligns with the license plate.

After that, the algorithm will find all the peaks in the HDV Graph for each horizontal segment. A peak is assumed to belong to a license plate if it is greater than a determined threshold.

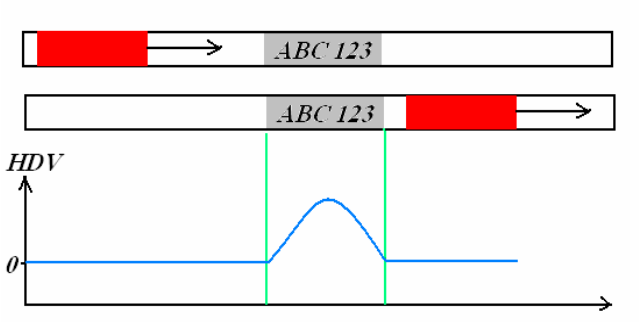


Fig: 6 Computation of HDV.

IV. CALCULATE IMAGE CATEGORY BASED ON THE HISTOGRAM DISTRIBUTION

We calculate the histogram distribution $\rho(0,1.2.....255)$ on the original image. These image categories are given their names as 'dark', 'medium' and 'fair'. Then, we compute the image category, θ as Equation.

$$\theta \begin{cases} \text{Dark} & \text{if } (\sum_{g=0}^{g=85}\rho g \geq \sum_{g=86}^{g=170}\rho g) \cap (\sum_{g=0}^{g=85}\rho g \geq \sum_{g=0}^{g=85}\rho g), \\ \text{Medium} & \text{if } (\sum_{g=86}^{g=170}\rho g \geq \sum_{g=0}^{g=85}\rho g) \cap (\sum_{g=0}^{g=85}\rho g \geq \sum_{g=0}^{g=85}\rho g), \\ \text{Fair} & \text{if } (\sum_{g=171}^{g=255}\rho g \geq \sum_{g=0}^{g=85}\rho g) \cap (\sum_{g=171}^{g=255}\rho g \geq \sum_{g=86}^{g=170}\rho g), \end{cases}$$

Where ρ the total of pixels within specific gray scale values is either from 0 until 85, 86 until 170 until 255 and ρ g is the current gray scale value.

V. DETECTION OF LICENSE PLATE USING IMAGE PROCESSING AND ITS IMPLEMENTATION OF MATLAB

The algorithm initially used various inbuilt functions and implemented few user defined routines related to image processing. Once the algorithm was developed, it was verified with multiple input images containing car number plates. The input images contained number plates that were aligned horizontally as well as at some angle from horizontal axis. Once the algorithm was completely verified, the in-built functions of MATLAB were replaced by user-defined functions.

A flow-chart showing the basic implementation of algorithm is shown fig. 7

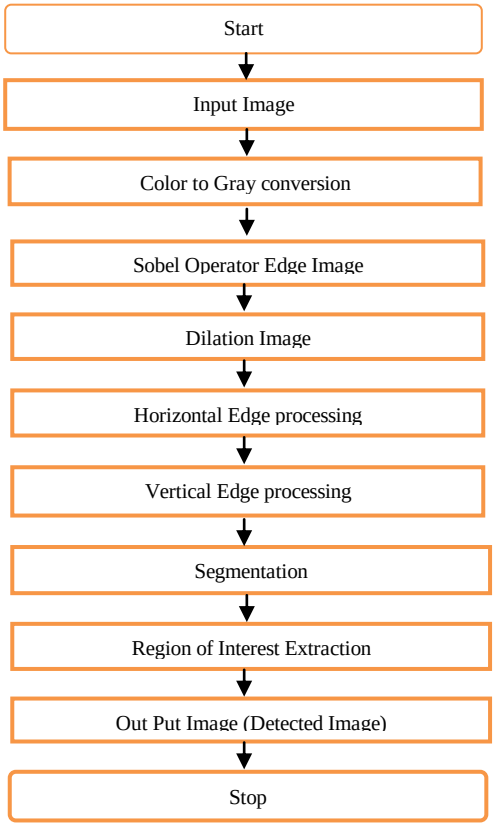


Fig: 7 Flow chart showing license plate detection algorithm in MATLAB.

VI. EXPERIMENTAL RESULTS

A. Experimental Results Using Skew Detection License Plate Image

Original Image conversation:

Fig 8.Image of the Original Image

Conversation of Original image to Gray Image

Fig. 9.Image of the Original Image

Find Edge in Image using Sobel Operator.

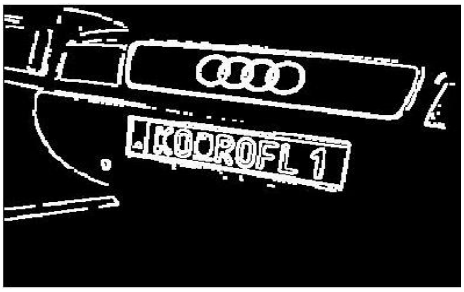
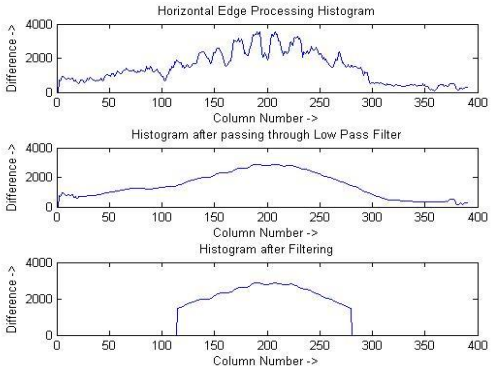


Fig: 10 Image of the Edge

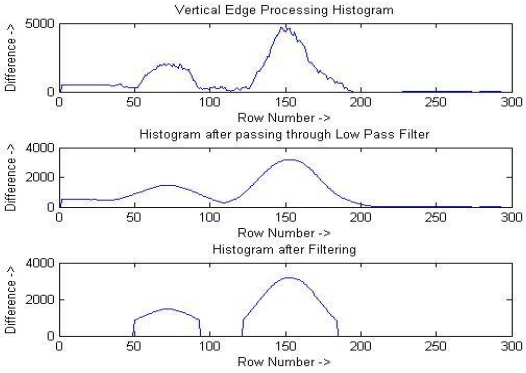
Conversation of Dilated Image.

Fig: 11 Image of the Dilated Image



Horizontal Histogram after Filtering.

Fig : 12 Image of the Horizontal Histogram



Vertical Histogram after Filtering.

Fig: 13 Image of the Vertical Histogram

Vehicle license Plate Segmentation Image

Fig: 14 Image of the Vehicle license Plate Segmentation Image

Vehicle License Plate Detection Image.

Fig: 15 Image of the Vehicle license Plate Detection Image

Vehicle License Plate Symbol Extraction Image.

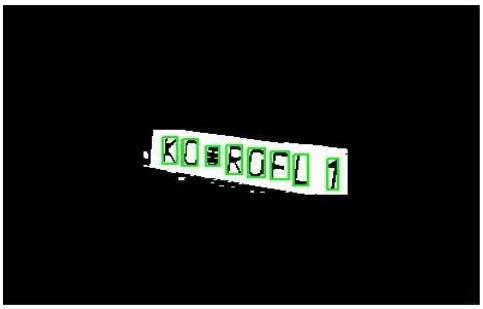


Fig: 16 Image of the Vehicle license Plate Extraction Image

VII. Conclusion

In this Report, Presented an effective vehicle license plate detection using Histogram Approach image processing steps. The proposed method used histogram approach for horizontal and vertical pixels. In this approach, initial image processing and binarization of an image is carried out based on the contrast between characters and background in license plate. After binarizing the image, it is divided into different black and white regions. These regions are passed through elimination stage to get the final region having most probability of containing a number plate.

Extraction of symbols and characters from document images is presented in which all the symbols should be disjointed. The major sources of error were due to symbols like % and = because it will take % as three different symbols and = as two symbols because they are disconnected. Black colored text printed on the white plate is preferred for better extraction rate.

We have used License Plate Detector Algorithm in any type of number plate and any language number plate.

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