Deblurring The Number Plate Of Moving Vehicles

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ABSTRACT*— Fast motion of vehicles may lead to difficulty in identifying the number plate by surveillance camera. Due to rapid motion of car the picture perceived by the camera develops a blur. To reduce this blur a BID (Blind Image Deconvolution) technique is proposed in which blur kernel is estimated using the parameters angle and length of blurred input number plate. The proposed system has tried to bring the idea of designing a robust method for motion blur estimation. The aim of this work is the retrieval of latent image which reduces the strain on human eyes in recognizing the blurry number plate. It can be useful in identifying problematic vehicles like in road accidents or catching any rule violating vehicle. But due to the speed of the vehicle, at exposure time it causes blur of the snapshots captured by the surveillance camera. This results into unrecognizable, undetectable and deterioration of image leading to loss of some image information. In such cases we can use image de-blurring to recover any useful clue from the snapshots for identification of car's number plate. The system is implemented and simulated on MATLAB and performance is tested on real images. This type of system is widely used in Traffic control areas, tolling, parking area.etc. This system is mainly designed for the purpose of security system.*

Keywords: BID, histogram equalization, blurry number plate, traffic control.

1.INTRODUCTION

Image Restoration is basically an operation or set of operations performed on noisy input image to estimate a latent clean and noise free output image. Noises found in image are mainly gaussian noise, salt-and-pepper noise, camera mis-focus etc. Motion blur occurs due to prolonged exposure time which creates blurry artifacts. It is the effect of relative motion between camera, objects and scene. Number plate is an identification number that peculiarly identifies the vehicle owner. It can be useful in identifying problematic vehicles like in road accidents or catching any rule violating vehicle. But due to the speed of the vehicle, at exposure time it causes blur of the snapshots captured by the surveillance camera. This results into unrecognizable, undetectable and deterioration of image leading to loss of some image information. In such cases we can use image de-blurring to recover any useful clue from the snapshots for identification of car's number plate.

The retrieval of such blurred image can be done by using non blind restoration and blind restoration. In non-blur restoration the information about the kernel is known, whereas in blind image restoration the kernel information is unknown.

Non-uniform image restoration is accomplished by interchanging the methods that caused the blurring of image i.e. first finding the PSF and then performing de-convolution whereas in uniform BID finding PSF and image restoration both are done simultaneously. The system has four main steps to get the required information. These are image acquisition, Pre processing, character segmentation and character recognition. This system is implemented and simulated in Matlab.

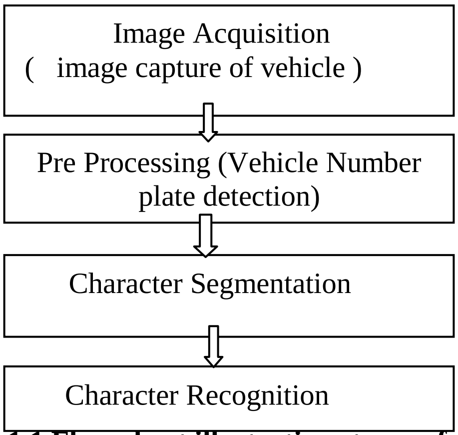

Fig 1.1 Flow chart illustrating stages of system

2. LITERATURE SURVEY

Vijayan Ellappan and Vishal Chopra published under number plate by IOP Publishing LtdIOP Conference Series: Materials Science and Engineering,Volume 263, Computation and Information Technology. Blur is a common in so many digital images. Blur can be caused by motion of the camera and scene object. In this work we proposed a new method for deblurring images. This work uses sparse representation to identify the blur kernel. By analyzing the image coordinates Using coarse and fine, we fetch the kernel based image coordinates and according to that observation we get the motion angle of the shaken or blurred image. Then we calculate the length of the motion kernel using radon transformation and Fourier for the length calculation of the image and we use Lucy Richardson algorithm which is also called NON-Blind(NBID) Algorithm for more clean and less noisy image output.

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As the unique identification of a vehicle, license plate is a key clue to uncover over-speed vehicles or the ones involved in hit-and-run accidents. However, the snapshot of over-speed vehicle captured by surveillance camera is frequently blurred due to fast motion, which is even unrecognizable by human. Those observed plate images are usually in low resolution and suffer severe loss of edge information, which cast great challenge to existing blind deblurring methods. For license plate image blurring caused by fast motion, the blur kernel can be viewed as linear uniform convolution and parametrically modeled with angle and length. In this paper, we propose a novel scheme based on sparse representation to identify the blur kernel. By analyzing the sparse representation coefficients of the recovered image, we determine the angle of the kernel based on the observation that the recovered image has the most sparse representation when the kernel angle corresponds to the genuine motion angle. Then, we estimate the length of the motion kernel with Radon transform in Fourier domain. Our scheme can well handle large motion blur even when the license plate is unrecognizable by human. We evaluate our approach on real-world images and compare with several popular state-of-the-art blind image deblurring algorithms. Experimental results demonstrate the superiority of our proposed approach in terms of effectiveness and robustness.

Chittode J S et al. developed algorithm which is applied on the car park systems to monitorand manage parking services. Algorithm is developed on the basis of morphological operations and used for number plate recognition. Optical character is used for the recognition of characters in number plate.

Chunyu C et al. presented a technique for recognition of number plate from vehicle image. This technique is implemented using MATLAB and characters are recognized using edge detection segmentation and pre-processing of image.

Ganapathy V et al. developed a methodology for Malaysian vehicles. This methodology is mainly based on Hough transform and morphological analysis and results extraction of number plate with 95% accuracy.

Kranti S et al. presented a methodology for number plate extraction named “Feature based number plate localization “. This methodology mainly deals on two methods edge detection and window filtering method.

3. DEBLURRING NUMBER PLATE SYSTEM

Image Restoration is basically an operation or set of operations performed on noisy input image to estimate a latent clean and noise free output image. Noises found in image are mainly gaussian noise, salt-and-pepper noise, camera mis-focus etc. Motion blur occurs due to prolonged exposure time which creates blurry artifacts. It is the effect of relative motion between camera, objects and scene. Number plate is an identification number that peculiarly identifies the vehicle owner. It can be useful in identifying problematic vehicles like in road accidents or catching any rule violating vehicle. But due to the speed of the vehicle, at exposure time it causes blur of the snapshots captured by the surveillance camera. This results into unrecognizable, undetectable and deterioration of image leading to loss of some image information. In such cases we can use image de-blurring to recover any useful clue from the snapshots for identification of car’s number plate.

The retrieval of such blurred image can be done by using non blind restoration and blind restoration. In non-blind restoration the information about the kernel is known, whereas in blind image restoration the kernel information is unknown. The blurring can be mathematically represented as

$$B(x, y) = (k * I)(x, y) + G(x, y) \quad (1)$$

where, B denote the blurred image, I is the sharp image we intend to recover and k is the blur kernel; G is the additive noise (usually regarded as white Gaussian noise); and $*$ denotes convolution operator [1]. In blind restoration, kernel k and sharp image I are unknown. Blind image restoration problem can be categorized into two ways: uniform BID and non-uniform BID [2]. Non-uniform image restoration is accomplished by interchanging the methods that caused the blurring of image i.e. first finding the PSF and then performing de-convolution whereas in uniform BID finding PSF and image restoration both are done simultaneously. The system has four main steps to get the required information. These are image acquisition, Pre processing (Number plate detection), character segmentation and character recognition. This system is implemented and simulated in Matlab.

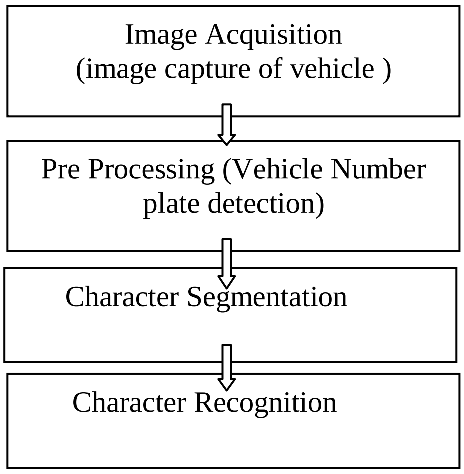

Fig 3.1 Flow chart illustrating stages of system

3.2 Pre-processing Stage

Pre-processing stage is the cleansing stage. The aim is to eliminate noise or distortion from the input image and making it simpler to carry out all processing operations. In pre-processing following operations are done i.e. grayscale conversion, Hann windowing and histogram equalization.

3.2.1 Grayscale Conversion

Grayscale images are those whose pixels carry only intensity information. Grayscale images reduce the computation by storing all information in 8 bits per sampled pixel. Converting the input images into grayscale make it uncomplicated in identifying the edges and other information. A luminosity method for Grayscale is used. Grayscale conversion is done in 3 steps:

1) Obtaining the RGB values.

2) Calculating the weighted mean using luminosity formula: 0.3R + 0.59G + 0.11B.

3) Replacing the old values of R.G.B with the calculated weighted mean.

3.2.2 Hann Windowing

Windowing is a mathematical function in which only a certain specified interval has a value rest are close to zero. Intervals having constant values are known as rectangular window. Windowing is done to limit the image size and to reduce boundary artifacts. Boundary artifacts occur due to sudden change in the pixels along the border. By removing unwanted frequencies/noise directional characteristics become clear. In this, we are using Hann windowing, among all the available windowing function because it has very low aliasing [9]. It is formulated as

$W(n) = 1/2(1-\cos(2*3.14*n/n-1))$

3.2.3 Histogram Equalization

Histogram equalization is the additional pre-processing step done to alter the contrast of the image. In this we not only stretch range of image but also have to determine equal pixels in all gray values. In this we first find pdf (Probability Distribution Function) and cdf (Cumulative Distribution Function) and then we round off the pixel values with the formula

$F = (L-1) * Sk;$

where, Sk is the cdf and L= the no of possible intensity values.

Considering a discrete grayscale image {r} and let nk be the number of occurrence of gray level k the pdf can be given as

$P(r) = nk/N$

where, N is the total number of pixels.

Fig 3.2 Output of Grayscale Conversion

Fig 3.3 Output of Histogram Equalization

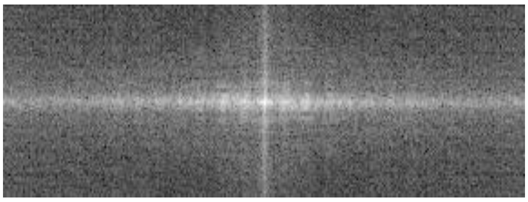

Fig 3.4 Log spectrum of blurred image

3.4 Blur Angle Estimation

The first step towards estimating angle is transforming the image from spatial domain to frequency domain. Frequency domain gives you control over the entire images, where you can improve and smoother attributes of image very easily. Motion blur in frequency domain has a dominant occurrence of black strips which can be detected. In this the blur is estimated by means of Hough transform. The spectrums of blurred images are anisotropic in nature and are biased within the direction perpendicular to the direction of blur.

Hough transform is mainly used for detection of lines, shapes and edges in an image. The proposed system uses log spectrum of the given image and then Hough transform is applied on it.

Algorithm: Motion Blur Angle Estimation

1) Compute the Fourier transform F(u,v) of the pre-processed image F(x,y).

2) Compute log spectrum of the output of step 2.

3) Compute the inverse Fourier transform of log spectrum.

4) Find the edge map of step 3 using any edge detection method (here canny edge detection is used).

5) Let α_{min} & α_{max} be minimum and maximum values of motion blur angle. Initialize accumulator array $A(r,\alpha)$ to zero. Repeat for each edge point (x_i,y_i) Repeat for $\alpha = \alpha_{min}$ to α_{max} { $r = x_i \cos \alpha + y_i \sin \alpha$ $A(r, \alpha) = A(r, \alpha) + 1$ $\alpha = \alpha + 1$ }

6) Find the max value in the accumulator array which is perpendicular to motion blur angle.

Fig 3.5 Detection of Hough Line after Canny edge detection

3.5 Blur Length Estimation

The obscure length is evaluated using spectral transform method. The spectrum is defined as

{f(x,y)} = F −1{ log| F{x,y}}

Where, F is the DFT and F−1 is the IDFT.

Here a 1D spectrum, extension of 1D i.e. 2D is used for filtering process and image registration process. As logarithm operators are used the spectral features are invariant to amplitude changes and as spectral transform is carried out in Fourier domain it is invariant to translation shift. In frequency domain it is observed that uniform motion blur has a periodic pattern by zero crossing of sine function. Spectrum or Spectral mainly works on frequency. With the image in frequency the image is turned by the angle found in previous module. Collapse the 2D into 1D spectral by taking average of the columns.

Algorithm: Motion Blur Length Estimation

1) Determine the spectral of input image F(x,y).

2) Rotate the spectral by the angle estimated in previous module in the inverse direction.

3)Collapse 2D matrix into 1D by taking the average of columns.

4) Find the distance of first negative peak from the origin which will be the blur length.

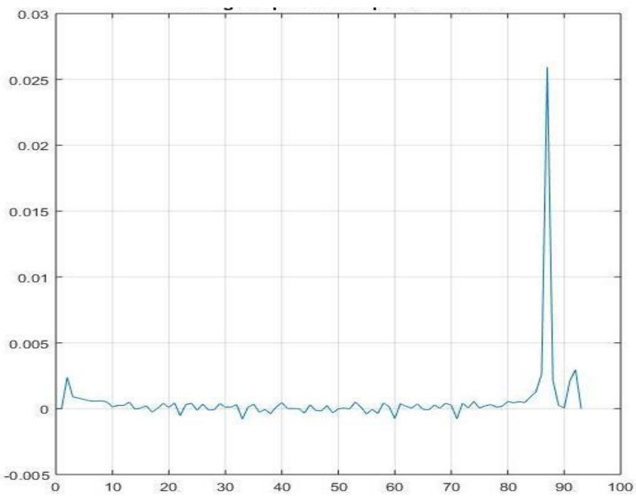

Fig 3.6 Average of pixels in Spectrum domain

3.6 Deconvolution

Here NBID method is used to get back the original deblurred image. NBID using Lucy-Richardson is used. In NBID as the kernel or psf is known and we get our blur kernel by creating a psf of obtained blur angle and length. Lucy-Richardson algorithm can be used effectively when the point-spread function PSF (blurring operator) is known, but little or no information is available for the noise. The blurred and noisy image is restored by the iterative, accelerated, damped Lucy-Richardson algorithm. You can use characteristics of the optical system as input parameters to improve the quality of the image restoration.

Step 1: Read Image

It reads in an RGB image and crops it to be 256-by-256-by-3. The deconvolution function can handle arrays of any dimension.

Step 2: Simulate a Blur and Noise

Simulate a real-life image that could be blurred due to camera motion or lack of focus. The image could also be noisy due to random disturbances. It simulates the blur by convolving a Gaussian filter with the true image. The Gaussian filter then represents a point-spread function PSF. It simulates the noise by adding a Gaussian noise of variance V to the blurred image. The noise variance V is used later to define a damping parameter of the algorithm

Step 3: Restore the Blurred and Noisy Image

Restore the blurred and noisy image providing the PSF and using only 5 iterations (default is 10). The output is an array of the same type as the input image.

Step 4: Control Noise Amplification by Damping

The latest image is the result of 15 iterations. Although it is sharper than the earlier result from 5 iterations, the image develops a "speckled" appearance. The speckles do not correspond to any real structures (compare it to the true image), but instead are the result of fitting the noise in the data too closely to control the noise amplification, use the damping option by specifying the DAMPAR parameter. DAMPAR has to be of the same class as the input image. The algorithm dampens changes in the model in regions where the differences are small compared with the noise. The DAMPAR used here equals 3 standard deviations of the noise. Notice that the image is smoother.The next part of this example explores the WEIGHT and SUBSMPL input parameters of the deconvlucy function, using a simulated star image (for simplicity & speed).

4. EXPECTED OUTCOME

The experimental results are implemented by using MATLAB, NetBeans with OpenCV libraries. The pre-processing part is carried out using NetBeans with OpenCV libraries. The estimation and de convolution part is implemented using MATLAB. Dataset is a mixture of few manually taken blurred images and few synthetically created blurred images.

Fig 4.1 Input blurred image by θ=90°, l=15

Fig 4.2 Output deblurred image after 80 iterations with θ=88°, l=14

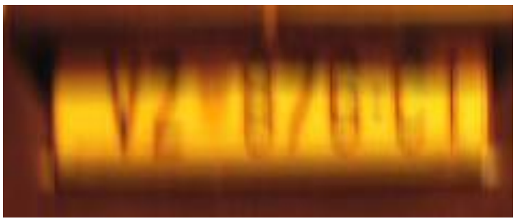

Fig 4.3 Input blurred image by θ=91°, l=15 taken at night time

Fig 4.4 Output deblurred image after 80 iterations with θ=89°, l=14

6. CONCLUSION

The proposed system has tried to emerge with a parametric method to deblur the number plate image. The information lost due to blurring is restored by estimating a blur kernel. For this, Hough transform and Spectral transform are used which are considered as efficient algorithms. Along with this, the characteristics of motion blur are also taken into consideration while founding the blur kernel. After estimating the kernel, NBID method is applied to get a deblurred number plate. The proposed system is able to restore the blur number plate image in human readable form.

REFERENCES

[1] M. Rishwana Yasmin, K. Sudharsana Devi, R. Sushmitha Sen, D.Victoria Dejee Singh and Mr. R.K.Sahu, “Deblurring Process for NumberPlate Images Using Kernel Estimation”, IOSR Journal of Electronics and Communication Engineering (IOSR-JECE).

[2] Qingbo Lu, Wengang Zhou, Lu Fang and Houqiang Li, “Robust Blur Kernel Estimation for Licence Plate Image from Fast Moving Vehicles”, IEEE Transactions on Image Processing.

[3] G. Abinaya, R. Banumathi and V. Seshasri, “Rectify the Blurred Licence Plate Image from Fast Moving Vehicles using Morphological Process”, SSRG Journal of Electronics and Communication Engineering.

[4] J.S. Chittode and R. Kate, “Number plate recognition using segmentation,” IJERT, ISSN: 2278-0181 Vol No:1

[5] C. Chunyu, W. Fucheng, C. Baozhi and Z. Chen,” Application of image processing to the vehicle numberplate recognition,” International Conference on Computer Science and Electronics Engineering, published by Allantis press, pp 2867-2869, 2013.

[6] S Kranti and K Pranathi, “Automatic number plate recognition,” International Journal of Advancements in Technology.