



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**

A futuristic digital interface with a glowing Earth globe in the center. The interface is overlaid on a background of a person's hands reaching out towards the globe. The interface includes various data visualizations such as bar charts, line graphs, and text boxes. Labels like 'BUSINESS', 'NETWORK SEARCH', 'LADING 100%', and 'MEDIA' are visible. The overall aesthetic is high-tech and blue-toned.

# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 13, Special Issue 1, April 2024

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 8.423

 9940 572 462

 6381 907 438

 [ijirset@gmail.com](mailto:ijirset@gmail.com)

 [www.ijirset.com](http://www.ijirset.com)

# Recognition of License Plate Images from Fast Moving Vehicles using Blur Kernel Estimation

<sup>1</sup>Mr. Venkatesan.M, <sup>2</sup>Mukesh.A.V, <sup>3</sup>Ranganarayanan.A, <sup>4</sup>Sundharamoorthy.P, <sup>5</sup>Vishnu.M

<sup>1</sup>Associate Professor, Department of Electronics and Communication Engineering, Adhiyamaan College of Engineering, Krishnagiri, Tamil Nadu, India

<sup>2, 3, 4, 5</sup> U.G Scholars Department of Electronics and Communication Engineering, Adhiyamaan College of Engineering, Krishnagiri, Tamil Nadu, India

**ABSTRACT:** The recognition of license plate information plays a pivotal role in accident investigations and monitoring traffic violations. However, surveillance cameras often capture license plate images in low resolution, complicating their analysis due to severe motion blur caused by fast-moving vehicles. Existing methods struggle to effectively restore these blurred images due to the loss of edge details and the complexity of motion. In this study, we propose an innovative technique based on sparse representation to overcome these challenges. By analyzing the sparse representation coefficients of the restored image, we can determine the angle of the blur kernel. We leverage the insight that the restored image achieves the sparsest representation when the kernel angle matches the genuine motion angle. Additionally, we employ the Radon transform in the Fourier domain to estimate the length of the motion blur kernel. Our method demonstrates remarkable efficacy in handling substantial motion blur, even when the license plate is indiscernible to the human eye. Through rigorous experimentation on real-world images, we compare our approach with several contemporary blind image deblurring algorithms, highlighting its superior performance in terms of effectiveness and robustness.

**KEYWORDS:** Blur, Kernel, license plate, restoration, vehicle.

## I. INTRODUCTION

The license plate serves as a unique identifier for every vehicle and is crucial for identifying vehicles involved in traffic violations. With the prevalence of automated speed detection systems on main roads and highways, capturing clear images becomes challenging due to vehicle motion during exposure. The duration of exposure, or shutter speed, significantly influences the amount of blur in the snapshot. In outdoor scenes with ample sunlight, typical exposure times are around 1/300 second. However, for a vehicle traveling at 60 miles per hour, the displacement of the license plate during exposure can be around 9 centimeters, comparable to the plate's size (14×44 centimeters in China). This translates to a blur kernel length of about 45 pixels for a license plate image sized 140×440 pixels, with the camera angle at approximately 60 degrees from the horizontal plane. In such conditions, motion blur becomes significant.

Under optimal lighting conditions, such as bright sunlight, shorter exposure times like 1/1000 second may result in minimal blur that does not compromise the semantic information in the image. However, in low-light situations, the camera may need to extend the exposure time to capture a properly exposed image, increasing the likelihood of motion blur. Additionally, high-resolution digital cameras used for high-speed videography are also susceptible to motion blur.

In addition to motion blur caused by vehicle movement, environmental factors such as weather conditions and road surface quality can also impact image clarity. Rain, fog, or dust can further degrade image quality, making it challenging for automated systems to accurately capture and interpret license plate information.

Despite these advancements, ongoing research and development efforts are needed to enhance the robustness and efficiency of license plate recognition systems. This includes exploring novel imaging techniques, optimizing algorithms for real-time processing, and improving the resilience of these systems against environmental challenges.

Ultimately, by overcoming the obstacles posed by motion blur and environmental factors, license plate recognition systems can continue to play a vital role in maintaining road safety, law enforcement, and traffic management initiatives.

## II. RELATED WORK

To restore natural images blurred by linear uniform motion and out-of-focus effects, a method leverages the spectrum of the blurred images, capitalizing on a common assumption valid for most natural images. The isotropic power spectrum exhibits a power-law decay with spatial frequency, facilitating modifications to the radon transform for identifying blur patterns. Blur parameters are estimated by fitting a function to both the natural image spectrum and the blur frequency response.

A unified probabilistic model is employed for de-blurring, encompassing both blur kernel estimation and un-blurred image restoration. Novel terms address common artifacts in current de-blurring methods, including a model for spatial randomness of noise in the blurred image and a local smoothness prior. This prior reduces ringing artifacts by constraining contrast in the un-blurred image where the blurred image exhibits low contrast. An efficient optimization scheme alternates between blur kernel estimation and image restoration, yielding high-quality de-blurred results in minimal computation time. Parallel processing techniques are utilized to expedite motion estimation and compensation computations, particularly beneficial for multi-core processors or GPU architectures. Algorithms are optimized for efficiency, minimizing redundant computations and memory overhead. Specialized data structures and algorithms tailored for real-time image stabilization enhance overall performance and effectiveness.

## III. METHODOLOGY

Utilizing the Hough transform to ascertain the blur direction involves treating the spectrum as an image and applying the transform to identify the orientation of the line within the spectrum. The Hough Transform (HT) is a crucial technique in image processing and computer vision for extracting integral features, adept at detecting basic geometric shapes like lines, circles, and ellipses in images. Its effectiveness extends to identifying distorted or partially obscured shapes, serving as a valuable tool when conventional edge detection methods prove inadequate. By converting image space into parameter space, the HT facilitates shape detection through pattern recognition in this transformed domain. The HT employs a voting mechanism in parameter space to highlight potential object candidates, offering robustness against image noise and incomplete feature boundaries. This adaptability renders it applicable across diverse domains such as medical imaging and manufactured part analysis. While the classical HT primarily focuses on standard curves and is computationally less demanding, the generalized HT caters to more intricate shapes where simple analytic descriptions are not applicable. In practical applications, the Hough transform can identify global patterns like lines, circles, and ellipses in an image by mapping them to parameter space. Its efficacy is particularly pronounced in line detection, as lines manifest as distinct points in the Hough transform space, leveraging the polar representation of the line.

$$\rho = x \cos \theta + y \sin \theta$$

In the realm of Cartesian coordinates, denoted by  $(x, y)$ , a line can be characterized by the angle  $(\theta)$  formed between the perpendicular from the origin to the line and the  $x$ -axis, along with the length  $(\rho)$  of this perpendicular. Thus, in polar coordinates, a line can be represented by a pair of coordinates  $(\rho, \theta)$ .

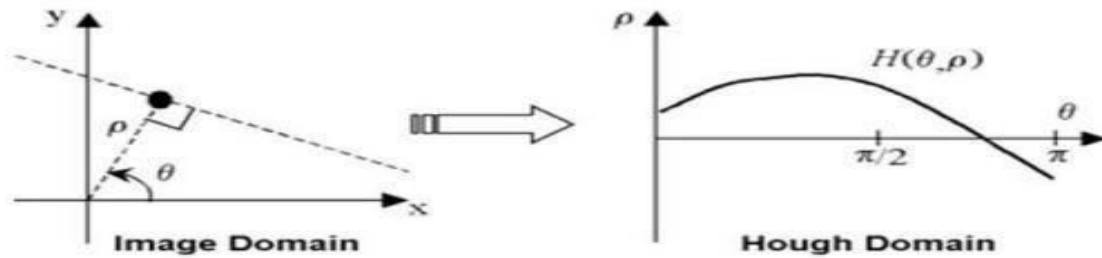


Figure no: 1 Hough transform

Cepstrum transform can be used for separation of blur components and image components. Cepstrum transform of an image  $f(x, y)$  is defined as follows

$$C\{f(x, y)\} = F^{-1}(\log |F(f(x, y))|)$$

Uniform motion blur in the frequency domain exhibits periodic patterns due to zero crossings of the sinc function, resulting in negative peaks in the cepstrum domain. Estimating the blur angle enables the determination of blur length in an image. In the cepstrum domain, the image is initially rotated. The Radon transform then computes the projection of the blurred image's log spectrum onto the x-axis at the estimated angle. Local minima in this projection correspond to dark lines separated by nearly identical distances (d). By detecting and averaging these minima distances, the final blur length can be computed. The Radon transform proficiently transforms two-dimensional images with lines into a domain of line parameters. Each line in the image produces a peak positioned at the corresponding line parameters. This transformation calculates the projections of an image matrix along specified directions, expressed as line integrals in the discrete domain equation

$$x \cos \theta + y \sin \theta = \rho.$$

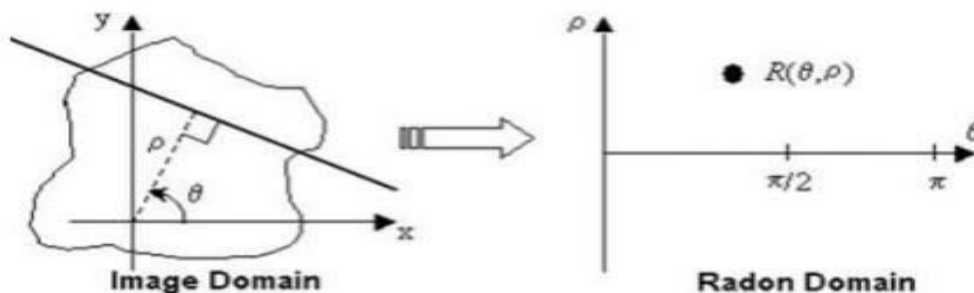


Figure no: 2 Radon transform.

If the dataset is affected by measurement noise, numerical interpolation may yield a jagged curve with sharp corners and significant interpolation error. An alternative technique involves numerically approximating the provided data values.

If a vehicle cannot be located immediately through the search module, the register module can be utilized. This module retrieves information about the desired vehicles using attributes such as vehicle number, user email ID, mobile number, and vehicle details. The vehicle number is compared with each input number from the embedded system, and if a match is found, an alert email is sent to the registered email ID. The register module's algorithm can be detailed as Algorithm.

Images captured by an embedded camera are processed using digital image processing techniques in MATLAB 2016 software. A unique edge detection algorithm enhances the efficiency of extracting the license plate region. A dedicated algorithm for segmenting characters in the license plate prevents character deformation. However, directly converting the grayscale image to a binary image by thresholding at 127 pixel values may not efficiently detect license plate edges when light intensity is uneven. The proposed algorithm enhances efficiency in detecting and extracting license plate regions from images with non-uniform light intensity.

Similarly, directly applying the Sobel edge mask to the grayscale image may not efficiently extract the license plate region under conditions such as high light intensity, shadows on the license plate, or light reflection. The proposed algorithm exhibits improved efficiency in extracting license plate regions compared to existing methods, as demonstrated in Table II (a).

#### IV. RESULTS



Figure no: 3 Input Video

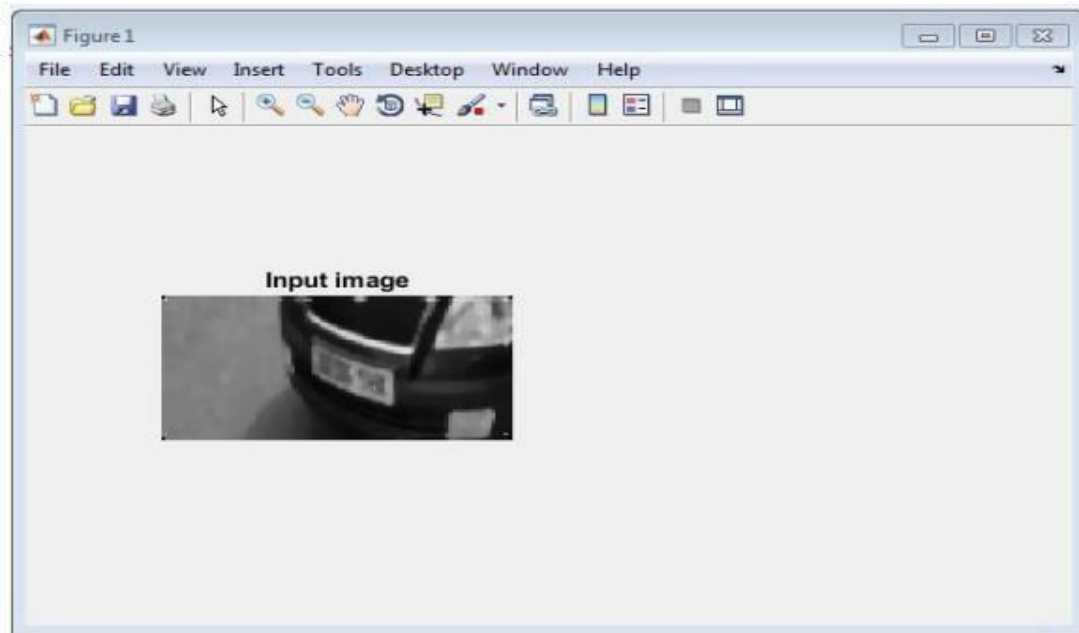


Figure no: 4 Input Image

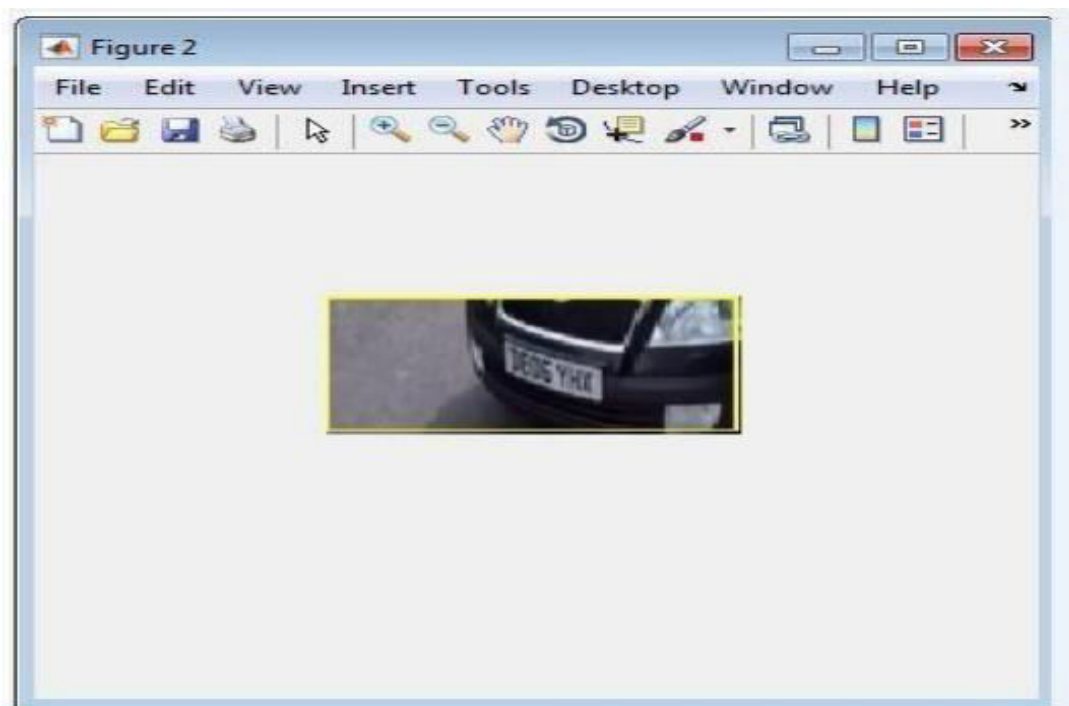


Figure no: 5 Shape Detector Output

## V. CONCLUSION

This project introduces a novel algorithm for estimating kernel parameters in the deblurring of license plates from fast-moving vehicles. With minimal assumptions, we approach the license plate deblurring as a parameter estimation challenge. We exploit an intriguing quasi-convex property of sparse representation coefficients associated with the kernel parameter (angle), enabling the design of a coarse-to-fine algorithm for efficient angle estimation. Length estimation leverages the power-spectrum characteristics of natural images. Our algorithm excels in handling very large blur kernels, making deblurred results readable even for license plates unrecognizable by humans. Additionally, our scheme exhibits robustness, benefiting from the simplicity of our model and its independence from strong assumptions regarding image content like edge or isotropic properties. While artifact may still be present in deblurred results, our focus on semantics greatly enhances license plate recognition in practical applications.

## REFERENCES

1. Kim, S. K., Kim, D. W., & Kim, H. J. (1996, September). A recognition of vehicle license plate using a genetic algorithm based segmentation. In *Image Processing, 1996. Proceedings., International Conference on* (Vol. 2, pp. 661-664). IEEE.
2. Arth, C., Limberger, F., & Bischof, H. (2007, June). Real-time license plate recognition on an embedded DSP-platform. In *Computer Vision and Pattern Recognition, 2007. CVPR'07. IEEE Conference on* (pp. 1-8). IEEE.
3. Ozbay, S., & Ercelebi, E. (2005). Automatic vehicle identification by plate recognition. *World Academy of Science, Engineering and Technology*, 9(41), 222- 225.
4. Sulehria, H. K., Ye Zhang, D. I., & Sulehria, A. K. (2008). Vehicle number plate recognition using mathematical morphology and neural networks. *WSEAS Transactions on Computers*, 7.
5. Qadri, M. T., & Asif, M. (2009, April). Automatic number plate recognition system for vehicle identification using optical character recognition. In *Education Technology and Computer, 2009. ICETC'09. International Conference on* (pp. 335- 338). IEEE.
6. Roy, A., & Ghoshal, D. P. (2011, March). Number Plate Recognition for use in different countries using an improved segmentation. In *Emerging Trends and Applications in Computer Science (NCETACS), 2011 2nd National Conference on* (pp. 1-5). IEEE.
7. Arulmozhi, K., Perumal, S. A., Priyadarsini, C. T., & Nallaperumal, K. (2012, December). Image refinement using skew angle detection and correction for Indian license plates. In *Computational Intelligence & Computing Research (ICCIC), 2012 IEEE International Conference on* (pp. 1-4). IEEE. Fig.
8. Results of proposed algorithm where (a) Table-1, (b) register module results, (c) Search module results and (d) Table-2 (c) (d) 9 8. Kaur, A., Jindal, S., & Jindal, R. (2012). License Plate Recognition using Support Vector Machine (SVM). *International Journal of Advanced Research in Computer Science and Software Engineering*, 2(7).
9. Roy, S., Choudhury, A., & Mukherjee, J. (2013). An approach towards detection of indian number plate from vehicle. *International Journal of Innovative Technology and Exploring Engineering (IJITEE)*, 2(4), 241-244.
10. Du, S., Ibrahim, M., Shehata, M., & Badawy, W. (2013). Automatic license plate recognition (ALPR): A state-of-the-art review. *IEEE Transactions on Circuits and Systems for Video Technology*, 23(2), 311-325.
11. Hsu, G. S., Chen, J. C., & Chung, Y. Z. (2013). Application-oriented license plate recognition. *IEEE Transactions on Vehicular technology*, 62(2), 552- 561.
12. Sulaiman, N., Jalani, S. N. H. M., Mustafa, M., & Hawari, K. (2013, August). Development of automatic vehicle plate detection system. In *System Engineering and Technology (ICSET), 2013 IEEE 3rd International Conference on* (pp. 130-135). IEEE.
13. Bhat, R., & Mehandia, B. (2014). Recognition of vehicle number plate using matlab. *International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering*, 2(8).
14. Kaur, S., & Kaur, S. (2014). An efficient approach for number plate extraction from vehicles image under image processing. *International Journal of Computer Science and Information Technologies*, 5(3), 2954-2959.
15. Chuang, C. H., Tsai, L. W., Deng, M. S., Hsieh, J. W., & Fan, K. C. (2014, August). Vehicle licence plate

- recognition using super-resolution technique. In Advanced Video and Signal Based Surveillance (AVSS), 2014 11th IEEE International Conference on (pp. 411-416). IEEE.
16. Sharma, J., Mishra, A., Saxena, K., & Kumar, S. (2014, February). A hybrid technique for license plate recognition based on feature selection of wavelet transform and artificial neural network. In Optimization, Reliability, and Information Technology (ICROIT), 2014 International Conference on (pp. 347-352). IEEE.
  17. Rabee, A., & Barhumi, I. (2014, May). License plate detection and recognition in complex scenes using mathematical morphology and support vector machines. In Systems, Signals and Image Processing (IWSSIP), 2014 International Conference on (pp. 59- 62). IEEE.
  18. Prabhakar, P., Anupama, P., & Resmi, S. R. (2014, July). Automatic vehicle number plate detection and recognition. In Control, Instrumentation, Communication and Computational Technologies (ICCICCT), 2014 International Conference on (pp. 185-190). IEEE.
  19. Raskar, R. R., & Dabhade, R. G. (2015). Automatic Number Plate Recognition (ANPR). International Journal of Emerging Technology and Advanced Engineering, 5.
  20. García-Sánchez, S., Aubert, S., Iraqui, I., Janbon, G., Ghigo, J. M., & d'Enfert, C. (2004). Candida albicans biofilms: a developmental state associated with specific and stable gene expression patterns. Eukaryotic cell, 3(2), 536-545.
  21. Dewan, S., Bajaj, S., & Prakash, S. (2015, June). Using Ant's Colony Algorithm for improved segmentation for number plate recognition. In Computer and Information Science (ICIS), 2015 IEEE/ACIS 14th International Conference on (pp. 313-318). IEEE.

#### BIOGRAPHY



Mr. Venkatesan M, Associate Professor,  
Electronics and Communication Engineering Department, Adhiyamaan college of  
Engineering,  
Hosur



Mukesh A V  
Electronics and Communication Engineering Department, Adhiyamaan college of  
Engineering,  
Hosur



Ranganarayanan A  
Electronics and Communication Engineering Department, Adhiyamaan college of  
Engineering,  
Hosur



**International Journal of Innovative Research in Science, Engineering and Technology**

*An ISO 3297: 2007 Certified Organization*

*Volume 13, Special Issue 1, April 2024*

**11<sup>th</sup> National Conference on Frontiers in Communication & Signal Processing Systems (NCFCSPS '24)**

**25<sup>th</sup> - 26<sup>th</sup> April 2024**

**Organized by**

**Department of ECE, Adhiyamaan College of Engineering, Hosur, Tamilnadu, India**



Sundharamoorthy P  
Electronics and Communication Engineering Department, Adhiyamaan college of Engineering,  
Hosur



Vishnu M  
Electronics and Communication Engineering Department, Adhiyamaan college of Engineering,  
Hosur



INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  [ijirset@gmail.com](mailto:ijirset@gmail.com)



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details