Moving Vehicle Registration Plate Detection

Dr Rama Abirami K[1]

Aishwarya Rani[2], Atul Kumar[3], Ayush Bhardwaj[4], Ayush Rungta[5],

ramaabirami1988@gmail.com[1] , aishrani177@gmail.com[2] ,
atulkumar.1dt19is022@gmail.com[3] ,ayushbhardwaj.1dt19is024@gmail.com[4] ,
rungta7.ayush@gmail.com[5]

Department of Information Science and engineering, Dayananda Sagar Academy of Technology And Management, Bangalore, India

Faculty in Department of Information Science and Engineering, Dayananda Sagar Academy of Technology And Management, Bangalore, India

Abstract

Number plates serve as a vehicle's distinctive identity (car). The current issue is finally resolved by a real-time plate detecting system assisted by image processing. In this document, we proposed a real-time vehicle number plate recognition (RVNPR) system for the recognition of number plates. The proposed system does not require the installation of additional hardware, such as GPS or radio frequency identification (RFID), since it uses image processing algorithms to extract the characters from the number plates of vehicles passing by a specific location. Advanced machine vision technology called license plate recognition is utilized to identify automobiles by their license plates without the direct involvement of a human. The data of vehicle numbers provided by this Intelligent Transportation System development can be used for monitoring, analysis, and follow- up. The number of automobiles on the road nationwide and in the automotive industry have grown dramatically during the past ten years. Keeping track of automobiles based on their license plates is vital for the better management of vehicular traffic. In order to maximize system performance with the least amount of effort and usage of computer resources, this study uses a variety of algorithms in each category, from number plate identification to character recognition.

Keywords— *Artificial Neural Networks, Character Segmentation, Contours, and Region of Interest in Image Processing (ROI)*

I. INTRODUCTION

The current generation of automobiles is widespread around the world. Thus, keeping tabs onautomobiles is crucial. In the modern era, we may utilize computers to track any vehicles without personally looking at them, which will result in more precision. Therefore, a vehicle number plate recognition system uses technology to recognize thenumber plate from footage the camera has acquired. It employs techniques including character recognition, segmentation, and number plate extraction. This method uses the license plate and then sends it to be converted to a picture using a combination of hardware and software. Any gate entrance can employ this technology.

Consequently, if the image that is taken from the system is accurate.

The ANPR is frequently used for traffic law enforcement, electronic toll collection, security control in restricted areas, unattended parking zones, etc. The following are the key steps to carrying out the suggested work:

1. Image capture
2. Identification of license plates
3. Detecting edges
4. Character Segmentation

5. Character recognition and database matching
If the characters are not properly separated, character recognition accuracy will be drasticallydecreased. Characters that are incorrectly segmented won't be recognized.
The use of Python for fast moving vehicle detection has become increasingly popular, and it is likelythat we will see further developments in this area in the future. Python is a popular programminglanguage for image processing and computer vision tasks, due to its ease of use, large ecosystem of libraries and frameworks, , and strong support for parallel and distributed computing. Many researchers and developers have explored the use ofPython for fast moving vehicle detection, and a wide range of algorithms and techniques have been proposed.

II. LITERATURE SURVEY

Fast moving vehicle detection has been a topic of significant interest in the field of computer vision and image processing. This literature survey will provide an overview of the various algorithms and techniques that have been proposed for detecting and tracking fast moving vehicles in video frames. One common approach to fast moving vehicle detection is to use background subtraction techniques. These techniques involve subtracting the current frame of a video from a reference background frame, which is typically obtained using a Gaussian mixture model or other statistical methods. The resulting foreground mask is then thresholded and processed to identify and track moving vehicles.

Another approach is to use specialized hardware, such as high-speed cameras and infrared sensors, to capture detailed images of the number plates evenat high speeds. This can allow for more accurate detection and recognition of the number plate information, although it may be more expensiveand complex to implement.

Other techniques that have been proposed for fast moving vehicle detection include optical flow algorithms, kalman filtering, and block-based motion estimation. These algorithms are often used in combination with background subtraction or deep learning methods for the advancement of the accuracy of vehicle detection and tracking.

In recent years, there has been a growing interest in using Python for fast moving vehicle detection. Python is a popular programming language for image processing and computer vision tasks, due to its ease of use, large ecosystem of libraries and frameworks, and strong support for parallel and distributed computing. There are many open-source libraries and frameworks, such as TensorFlow and PyTorch, that can be used to develop and train machine learning models for number plate detection. These libraries provide a wide range of tools and features that can be used to build and optimize machine learning models for this application. Many researchers and developers have explored the use of Python for fast moving vehicle detection, and a wide range of algorithms and techniques have been proposed.

One notable example is the OpenCV library, which provides a comprehensive set of tools and algorithms for computer vision tasks, including fast moving vehicle detection. OpenCV includes implementations of many popular algorithms, such as background subtraction, optical flow, and CNNs, as well as a range of utility functions and high-level interfaces for building more complex applications. Another example is the scikit-image library, which provides a collection of algorithms and tools for image processing tasks, including vehicle detection. scikit-image includes implementations of many popular image processing algorithms, such as thresholding, edge detection, and feature extraction, as well as a range of utility functions for loading, displaying, and manipulating images.

Background subtraction techniques have been widely used in a variety of applications, including surveillance, traffic monitoring, and pedestrian detection. One of the key advantages of these techniques is their ability to adapt to changes in the background scene, such as lighting changes or moving objects in the background. However, they can also be sensitive to noise and artifacts in the video, such as shadows and reflections, which can lead to false detections or missed detections.

To address these issues, many researchers have proposed methods for improving the accuracy and robustness of background subtraction algorithms.

These methods include using multiple reference background frames, incorporating spatial and temporal information into the background model, and applying post-processing steps to filter out false detections.

For example, Elgammal et al. proposed a method for constructing a background model using amixture of Gaussian distributions, where each distribution represents the intensity of a pixel in the background image. The mixture model is updated over time to account for changes in the background scene, and the resulting model is used to estimate the probability of a pixel belonging to the foreground or background. The foreground mask is then obtained by thresholding the probability map, and further processed to identify and track moving objects.

Another approach is to use a more complex background model, such as a Markov random field (MRF), to capture the spatial and temporal dependencies between pixels in the background image. This allows the background model to adapt to more complex changes in the scene, such as moving objects in the background or occlusions.

For example, Stauffer and Grimson proposed a method for constructing an MRF background model using a mixture of Gaussians, where each Gaussian is associated with a spatial location in the background image. The model is updated over time using a Monte Carlo sampling procedure, and the resulting probabilities are used to obtain the foreground mask and identify moving objects.

Once the foreground mask has been obtained, it is typically processed to identify and track moving objects. This can be done using a variety of methods, such as connected component analysis, blob detection, and contour tracing.

For example, Ramesh et al. proposed a method for identifying and tracking vehicles in a traffic surveillance system using connected component analysis. The foreground mask is thresholded to obtain a binary image, and connected components are identified and labeled. The size, shape, and position of each component are then used to classify it as a vehicle or a non-vehicle object. The position and orientation of the vehicle are then estimated using a Kalman filter, and the vehicle is tracked over time.

Another approach is to use deep learning algorithms, such as convolutional neural networks (CNNs), to directly detect and classify vehicles in video frames. These algorithms are trained on large datasets of annotated vehicle images, and can achieve high accuracy in detecting and classifying vehicles.

Deep learning algorithms have become increasingly popular in recent years, due to the availability of powerful computational resources and large datasets, as well as advances in training algorithms and network architectures. CNNs, inparticular, have been shown to be effective for many computervision tasks, including object detection and classification. Neural networks are a type of machine learning algorithm that can be used for detecting moving vehicle number plates. Neural networks are composed of many interconnected processing units, called neurons, that are able to learn and adapt to new data. In the context of detecting moving vehicle number plates, a neural network can be trained on a large dataset of images and videos of vehicles, including their number plates, and then be used to recognize and extract the number plate information from new, unseen images and videos.

There are several advantages of using neural networks for detecting moving vehicle number plates. One advantage is their ability to learn complex patterns and relationships from data,which can allow the neural network to achieve high accuracy and robustness in detecting and recognizing number plates, even in challenging conditions. Another advantage is the flexibility of neural networks, which can be easily customized and adapted to different applications and requirements. In order to use neural networks for detecting moving vehicle number plates, it is necessary totrain the neural network on a large andrepresentative dataset of images and videos of vehicles and their number plates. This can involve collecting and annotating a dataset of images and videos, which can be a time- consuming and labor- intensive process.

Once the neural network has been trained, it can be used to detect and recognize number plates from new images and videos. This can involve applying image processing techniques, such as image segmentation and feature extraction, to extract the relevant information from the images and videos, and then using the trained neural network to classify and recognize the number plate information.In addition to the advantages mentioned above, neural networks have several other advantages that make them well- suited to detecting moving vehicle number plates. For example, neural networks are able to process large amounts of data quickly and efficiently, and can be easily parallelized across multiple devices, such as GPUs and CPUs, to accelerate their computation. This makes them well-suited to handling the large amounts of data that are typically involved in detecting moving vehicle number plates.

Furthermore, neural networks are able to adapt and improve their performance over time, as they continue to learn from new data. This can allow them to maintain high accuracy and robustness evenin the face of changing conditions, such as newtypes of number plates or variations in lighting and background.

Overall, neural networks provide a powerful and effective approach to detecting moving vehicle number plates, and have the potential to enable new and exciting applications in this area. By leveraging the capabilities of neural networks, it is possible to develop highly accurate and efficient algorithms for detecting and recognizing number plates from moving vehicles, which can provide valuable information and insights for a wide range of applications.

The following is a high-level block diagram for number plate detection:

1. Input: A video frame or image containing a vehicle with a number plate.
2. Pre-processing: The input frame is pre-processed to remove noise and artifacts, such as reflections and shadows.
3. Number plate localization: The frame is processed to identify regions that are likely to contain a number plate. This is typically done using a combination of edge detection, blob detection,and contour tracing algorithms.

4. Number plate recognition: The identified number plate region is processed to extract and recognize the characters on the number plate. This is typically done using a combination of image segmentation, feature extraction, and classification algorithms.
5. Output: The recognized number plate and its corresponding characters are output for further processing.

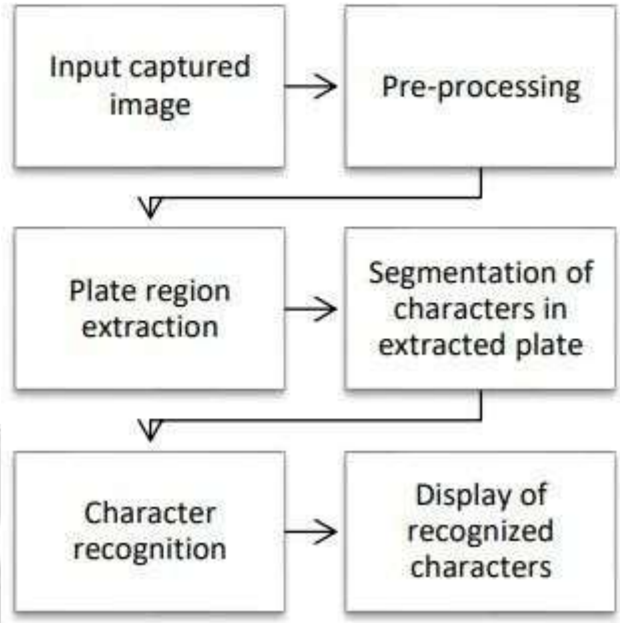

Fig 1: Flow Diagram representing number plate extraction

Image processing techniques play an important role in detecting and recognizing number plates in video frames or images. Some common techniques used in this task include:
1. Edge detection: Edge detection algorithms are used to identify sharp changes in the intensity or colour of an image, which can correspond to the boundaries of objects or features in the scene. These algorithms typically involve convolving the image with a filter kernel that is sensitive to changes in intensity or colour, and thresholding the resulting output to obtain a binary edge map.
2. Blob detection: Blob detection algorithms are used to identify connected regions of an image that have a certain size, shape, or colour. These algorithms typically involve applying morphological operations, such as erosion and dilation, to the image to remove noise and isolate regions of interest, and then applying a set of criteria to identify and label the resulting blobs.

3. Contour tracing: Contour tracing algorithms are used to identify closed curves in an image, such as the contours of objects or features in the scene.These algorithms typically involve following theedge map obtained from edge detection, andidentifying and tracking the contours of connected components in the edge map.
4. Image segmentation: Image segmentation algorithms are used to divide an image into multiple regions or segments, where each region corresponds to a different object or region of interest in thescene. These algorithms can be based on a varietyof principles, such as colour, texture, shape, or spatial location, and can use a combination of bottom-up and top-down approaches to partition theimage into segments.
5. Feature extraction: Feature extraction algorithms are used to extract meaningful and distinctive characteristics from an image or region of interest. These characteristics, or features, can include colour histograms, texture descriptors, shape descriptors, and gradient orientations, among others. The extracted features can then be used as input to a classification algorithm to identify the objects or regions in the image.
Character recognition techniques are also used in detecting and recognizing number plates in video frames or images. These techniques involve analyzing the extracted number plate region to identify and recognize the individual characters on the number plate. Some common techniques used in this task include:
1. Image segmentation: Image segmentation algorithms are used to divide the number plate region into individual segments, where each segment corresponds to a single character on the number plate. This can be done using a variety of methods, such as connected component analysis, template matching, or clustering algorithms.
2. Feature extraction: Feature extraction algorithms are used to extract distinctive characteristics from the individual character segments, such as colour histograms, texture descriptors, or shape descriptors. The

extracted features are then used as input to a classification algorithm to identify the individual characters.

3. Classification: Classification algorithms are used to assign each character segment to a class, or label, corresponding to one of the possible characters on the number plate. These algorithms can be based on a variety of principles, such as support vector machines, decision trees, or neural networks, and are typically trained on a large dataset of labeled character images.
4. Recognition: The recognized characters are then assembled to form the complete number plate, and the resulting number plate is output for further processing. This can involve applying additional post-processing steps, such as error correction or OCR, to improve the accuracy and reliability of the recognition results.

III. CONCLUSION

In conclusion, moving vehicle number plate detection is a challenging but important task in the field of computer vision and image processing. It has many potential applications, such as traffic surveillance, vehicle tracking, and toll collection. A variety of algorithms and techniques have been proposed for this task, including background subtraction, deep learning, optical flow, kalman filtering, and block-based motion estimation. These algorithms can be combined and customized to achieve high accuracy and robustness in detecting and recognizing number plates in video frames. However, the performance of these algorithms can be affected by factors such as noise, lighting conditions, camera angles, and vehicle speed, and thus continued research and development is needed to improve their accuracy and efficiency.

In summary, moving vehicle number plate detection is a complex and challenging task, but it has many potential applications and a wide range of algorithms and techniques have been proposed for addressing this task. Continued research and development is needed to improve the accuracy, efficiency, and robustness of these algorithms, and to explore new applications and scenarios for moving vehicle number plate detection.

REFERENCES

[1] N. Ukani and H. Mehta, "An accurate method for license plate localization using morphological operations and edge processing," 2010 3rd International Congress on Image and Signal Processing, 2010, pp. 2488-2491, doi: 10.1109/CISP.2010.5647926.

[2] A. O. Agbeyangi, O. A. Alashiri and A. E. Otunuga, "Automatic Identification of Vehicle Plate Number using Raspberry Pi," 2020 International Conference in Mathematics, Computer Engineering and Computer Science (ICMCECS), 2020, pp. 1-4, doi: 10.1109/ICMCECS47690.2020.246983.

[3] P. Shah, S. Karamchandani, T. Nadkar, N. Gulechha,
K. Koli and K. Lad, "OCR-based chassis-number recognition using artificial neural networks," 2009 IEEE International Conference on Vehicular Electronics and Safety (ICVES), 2009, pp. 31-34, doi: 10.1109/ICVES.2009.5400240.

[4] H. Li, P. Wang and C. Shen, "Toward End-to-End Car License Plate Detection and Recognition With Deep Neural Networks," in IEEE Transactions on Intelligent Transportation Systems, vol. 20, no. 3, pp. 1126-1136, March 2019, doi: 10.1109/TITS.2018.2847291.

[5] S. Huang, H. Xu, X. Xia and Y. Zhang, "End-to-End Vessel Plate Number Detection and Recognition Using Deep Convolutional Neural Networks and LSTMs," 2018 11th International Symposium on Computational Intelligence and Design (ISCID), 2018, pp. 195-199, doi: 10.1109/ISCID.2018.00051.

[6] X. -W. Zhang, X. -g. Liu and J. Zhao, "A Vehicle License Plate Recognition Method Based on Neural Network," 2010 IEEE International Conference on Granular Computing, 2010, pp. 845-847, doi: 10.1109/GrC.2010.126.

[7] G. Alkawsi, Y. Baashar, A. A. Alkahtani, T. S. Kiong, D. Habeeb and A. Aliubari, "Arabic Vehicle Licence Plate Recognition Using Deep Learning Methods: Review," 2021 11th IEEE International Conference on Control System, Computing and Engineering (ICCSCE), 2021, pp. 75-79, doi: 10.1109/ICCSCE52189.2021.9530940.

[8] D. M. F. Izidio, A. P. A. Ferreira and E. N. S. Barros, "An Embedded Automatic License Plate Recognition System Using Deep Learning," 2018 VIII Brazilian

Symposium on Computing Systems Engineering (SBESC), 2018, pp. 38-45, doi: 10.1109/SBESC.2018.00015.

[9] R. Pan, X. Ma and L. Wang, "An Efficient Method for Skew Correction of License Plate," 2010 Second International Workshop on Education Technology and Computer Science, 2010, pp. 90-93, doi: 10.1109/ETCS.2010.14.

[10] F. Faradji, A. H. Rezaie and M. Ziaratban, "A Morphological-Based License Plate Location," 2007 IEEE International Conference on Image Processing, 2007, pp. I - 57-I - 60, doi: 10.1109/ICIP.2007.4378890.

[11] I. M. Gorovyi and I. O. Smirnov, "Robust number plate detector based on stroke width transform and neural network," 2015 Signal Processing Symposium (SPSympo), 2015, pp. 1-4, doi: 10.1109/SPS.2015.7168289.

[12] A. M. Davis, C. Arunvinodh and N. P. A. Menon, "Automatic license plate detection using vertical edge detection method," 2015 International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS), 2015, pp. 1-6, doi: 10.1109/ICIIECS.2015.7193073.

[13] N. Bharti, M. Kumar and V. M. Manikandan, "A Hybrid System with Number Plate Recognition and Vehicle Type Identification for Vehicle Authentication at the Restricted Premises," 2022 2nd International Conference on Emerging Frontiers in Electrical and Electronic Technologies (ICEFEET), 2022, pp. 1-6, doi: 10.1109/ICEFEET51821.2022.9847975.

[14] A. Sharma, A. Dharwadker and T. Kasar, "MobLP: A CC-based approach to vehicle license plate number segmentation from images acquired with a mobile phone camera," 2010 Annual IEEE India Conference (INDICON), 2010, pp. 1-4, doi: 10.1109/INDCON.2010.5712593.

[15] G. -W. Chen, C. -M. Yang and T. -U. İk, "Real- Time License Plate Recognition and Vehicle Tracking System Based on Deep Learning," 2021 22nd Asia- Pacific Network Operations and Management Symposium (APNOMS), 2021, pp. 378-381,doi: 10.23919/APNOMS52696.2021.9562691.