2023 International Conference on Computational Intelligence, Communication Technology and Networking (CICTN) | 979-8-3503-3802-7/23/$31.00 ©2023 IEEE | DOI: 10.1109/CICTN57981.2023.10141318

A Review Paper on Automatic Number Plate Recognition using Machine Learning

An In-Depth Analysis of Machine Learning Techniques in Automatic Number Plate Recognition: Opportunities and Limitations

Rajat Kumar Prajapati
Department of Computer science & Engineering
Geetanjali Institute of Technical Studies
Udaipur, Rajasthan, India
Rajat.kumar2771@gmail.com

Yatharth Bhardwaj
Department of Computer science & Engineering
Geetanjali Institute of Technical Studies
Udaipur, Rajasthan, India
theyatharth001@gmail.com

Ritesh Kumar Jain
Assistant Professor, CSE
Geetanjali Institute of Technical Studies
Udaipur, Rajasthan, India
ritesh.jain@gits.ac.in

Dr. Kamal Kant Hiran
Associate Professor, CSE
Symbiosis University of Applied Sciences
Indore, Madhya Pradesh, India
kamalkant.hiran@suas.ac.in

***Abstract*—The recognition of license plates, known as Automatic Number Plate Recognition (ANPR), is an important topic in the fields of smart transportation systems and image recognition. ANPR has the potential to significantly improve traffic control and safety measures in urban areas. Its primary objective is to automatically detect and recognize the characters on vehicle license plates using modern technology and image processing techniques. With the rapid increase in the number of vehicles, ANPR has become a crucial tool for traffic control and management. In recent years, ANPR technology has advanced significantly, leading to the development of protocols such as OCR, which enables the recognition of license plate locations and allows traffic surveillance to address various issues, such as criminal investigations, toll collection, speed control, and parking management. ANPR systems play a vital role in traffic control and surveillance, and several systems have been developed to recognize license plates, each with its specific advantages. The key steps involved in an ANPR system are the precise localization of the number plate, segmentation, and recognition. This paper presents an efficient and layout-independent ANPR system that can accurately detect and recognize license plates, thus enhancing traffic control and surveillance measures.**

Keywords*— *YOLO, ANPR, OCR, CNN, Character Segmentation, Text Recognition, Object Detection, ML, Deep Learning.

I. INTRODUCTION

The development of Automatic Number Plate Recognition (ANPR) systems has become increasingly important in recent years to enhance traffic control and safety measures. This technology has numerous applications, including detecting traffic violations, toll collection, tracking traffic flow, and identifying stolen vehicles. ANPR systems have three crucial components: Number Plate (NP) detection, character segmentation, and character recognition. The first stage involves locating the number plate in the image, which can be challenging due to variations in lighting, perspective, and license plate design. The second stage involves accurately segmenting each character within the detected number plate, which can be complicated due to variations in font size, style, and spacing. Finally, the third stage involves character recognition using various algorithms, including optical character recognition (OCR), neural networks, or template matching. The accuracy of each stage is critical to the overall effectiveness of ANPR systems, as a failure in any stage can significantly impact system accuracy, leading to false positives or false negatives. Therefore, researchers and developers must improve ANPR technology to achieve higher accuracy and efficiency. With advancements in computer vision, deep learning, and hardware technology, ANPR systems are poised to play an increasingly important role in the development of smart transportation systems in the future.

Despite significant advancements in computer vision using deep learning, many solutions still lack the robustness required for real-world scenarios. These solutions often rely on specific constraints, such as precise cameras, simple backgrounds, suitable lighting conditions, and certain types of vehicles. Even computationally expensive methods can struggle to process frames in real-time, particularly on mid-range GPUs that are commonly used in real-world applications. For ANPR systems to be truly effective, they must be capable of recognizing multiple number plate layouts. However, most current solutions only work for a specific layout, limiting their applicability in the context of smart transportation systems. A robust and efficient ANPR system can play a crucial role in a range of applications, including vehicle re-identification, which is a challenging problem due to the similarity between different vehicles with the same model and color. To improve detection algorithms, it is essential to reduce the size of the original high-resolution image without sacrificing license plate detection performance. However, down-sampling techniques can introduce negative outcomes, which must be carefully considered in the development of ANPR systems. By addressing these challenges and developing more robust and efficient ANPR systems, we can enhance traffic control and safety measures and improve the overall effectiveness of smart transportation systems.

In the late 1970s, the UK's Police Scientific Development Branch introduced the first-ever ANPR system, laying the foundation for the development of modern-day ANPR technology. The initial prototype was not operational until 1979, and the manufacturing contract was awarded to EMI Electronics. However, the project was later handed over to Computer Recognition Systems (CRS), based in Wokingham, UK, for further development and refinement. The CRS team continued to enhance the technology, leading to the emergence

of more advanced ANPR systems that are now widely used for traffic control, safety measures, and law enforcement purposes.

Fig. 1. General processes of the number plate recognition system.

II. PRIMARY APPLICATIONS OF ANPR

ANPR technology has become increasingly important in modern society due to its versatile applications in areas such as law enforcement, traffic control, and security systems. The ability to automatically detect and recognize license plates has greatly enhanced the efficiency and accuracy of various processes, ranging from toll collection to parking management. Furthermore, ANPR systems have proven to be invaluable tools in identifying and tracking stolen or suspect vehicles, as well as monitoring traffic violations and enforcing traffic laws. As such, the development and improvement of ANPR technology continue to be a crucial area of research and innovation.

A. ***Low Enforcement:-*** Police forces worldwide utilize ANPR technology to improve their law enforcement capabilities. By scanning and recognizing number plates in real time, ANPR systems help authorities identify and track vehicles associated with criminal activity. ANPR technology can be used to check if a vehicle is registered, identify stolen vehicles, track traffic flow, detect traffic violations, and even identify wanted suspects. The ability to quickly and accurately identify vehicles and their associated information has proven to be a game-changer for law enforcement agencies, leading to increased safety and security for communities.

B. ***Smart Parking management*** Effective vehicle parking management requires a comprehensive solution that can accurately detect individual vehicles. Automatic Number Plate Recognition (ANPR) technology is the backbone of modern vehicle parking management systems. ANPR enables parking garages to implement automatic parking administration by identifying each vehicle using its license plate number. With such smart parking systems in place, parking garage operators can keep track of every vehicle within the facility and ensure complete governance. Customers no longer need to stress about managing their parking tickets or monitoring the time spent, avoiding the risk of penalties for inaccurate ticket payments or losing their tickets. Furthermore, automatic surveillance can be utilized as evidence in case of any disputes. ANPR technology offers a reliable and efficient way to manage parking facilities, improving the overall parking experience for both operators and customers.

C. ***Intelligent traffic management****:-* ANPR technology offers a wide range of benefits under the umbrella of traffic management. It can be utilized in cities to detect overspeeding vehicles, reckless driving, and accidents. ANPR also provides the means to measure and analyze traffic data for specific locations or entire cities. With the ability to gain insights into traffic congestion, traffic management enables better planning for efficient transportation on a larger scale. These advantages can help improve overall road safety and reduce traffic-related issues in urban areas.

D. Toll-Plaza

In many parts of the world, toll plaza administration on highways still heavily relies on manual processes. However, there has been a growing trend toward implementing automated toll stations that leverage various technologies to improve toll booth management. One such technology is ANPR, which allows authorities to receive license plate numbers for toll payment via mail or automated electronic toll collection systems without the need to stop at a manually-run tollbooth. ANPR technology not only facilitates efficient toll booth management, but it also enables dynamic road pricing, which allows toll prices to vary based on factors such as time of day,

vehicle type, and traffic congestion. By reducing the operational time needed for toll collection, ANPR helps increase productivity and reduce traffic congestion on highways, ultimately resulting in a better driving experience for commuters.

In addition, ANPR technology has found its applications in various fields such as access control, parking management, toll collection, and even in retail stores for analyzing consumer behavior. As the world moves towards smart cities and advanced transportation systems, the need for accurate and efficient ANPR systems will only continue to grow. Furthermore, advancements in AI and machine learning are expected to lead to even more sophisticated ANPR solutions that can handle complex scenarios and provide valuable insights for a range of applications.

III. GOLES OF ANPR

Automated recognition of number plates has become an essential tool for extracting valuable information from vehicles. However, the traditional manual method of identifying the vehicle and its owner is no longer suitable for detecting number plates to extract the desired information. Hence, Automatic Number Plate Recognition (ANPR) is considered the optimal solution for extracting numeral plate information. However, different recognition methods are required for the extraction of information from number plates. The ANPR process involves two main modules:

1. Number plate detection
2. Number plate recognition

To detect vehicle number plates, the first step is to acquire the input image, followed by image pre-processing which includes gray-scale conversion and noise reduction. Then, character segmentation, feature extraction, classification, and identification are performed to recognize the number plate.

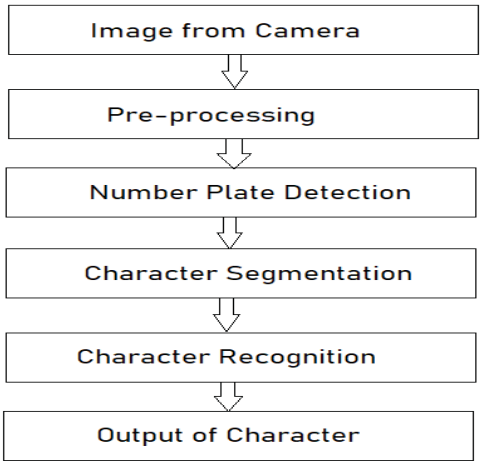

Fig. 2. Steps in ANPR

IV. FEATURES OF ANPR

Automatic Number Plate Recognition (ANPR) is computer software that recognizes and decodes license plates captured by cameras. ANPR software is designed to read and interpret license plates accurately and efficiently. It is also referred to as Automatic License Plate Recognition (ALPR). The software creates a record of all number plates that are captured, along with associated information such as date, time, and GPS location. ANPR software uses Optical Character Recognition (OCR) technology to recognize and extract characters from license plates, enabling fast and accurate processing of data.

Cost and Growth Projections: ANPR technology is available in various types, each with different components, uses, and geographical areas, resulting in different price categories. The purchasing decision depends on the specific requirements and budget of the authorities. In 2016, the global market value of ANPR technology was estimated to be around USD 1.78 billion. It is projected that this value will increase to USD 3.57 billion by the end of 2023, indicating a significant growth in demand for ANPR systems in various industries and applications.

ANPR Camera Specifications and Requirements: Automatic Number Plate Recognition (ANPR) systems consist of various components, including cameras of different sizes and qualities, depending on the system's cost. The type of camera used can either be infrared, color, or a combination of both. The accuracy of ANPR systems can be affected by the number of frames the camera takes. ANPR cameras typically include an IR lamp, speedy shutter, and zooming manipulation of the lens to capture clear images. To manage parking lots and collect tolls automatically, a minimum of 2MP camera is required, while logistics or vehicle repair works require a 4MP camera. For highway traffic monitoring, an 8MP camera is needed to capture clear images of the number plates. For better plate recognition, about 40 pixels of width are required. The camera's distance from the conveyance should be minimal, ideally less than 35 meters, and the vertical angle of the camera on the license plate should be less than 45 degrees. The horizontal perspective of the camera must also be less than 45 degrees to ensure maximum accuracy in capturing number plates.

Ease of use: In ANPR systems, capturing images of vehicle license plates can result in large amounts of data that require significant bandwidth and storage capacity. To address this challenge, many systems have implemented image-to-text conversion techniques to reduce the amount of data being stored. This involves converting the captured license plate images into text format and maintaining only the record of plate numbers, along with the date and time of capture. By reducing the storage space required for ANPR data, these techniques enable more efficient and cost-effective implementation of the technology for law enforcement and other applications.

ADVANTAGES OF ANPR

ANPR technology provides several advantages that make it a preferred choice for various applications.

- It helps in managing visitors by detecting outside vehicles and monitoring their entry and exit.
- ANPR systems can reduce manual traffic checks and provide access permissions to authorized personnel only, which increases overall security.
- By using ANPR, human error is reduced, and unauthorized vehicles can be detected easily.
- ANPR is also an efficient way for resource management, as it allows for the detection of workers in and out of time.
- In parking management, ANPR devices play an essential role in controlling traffic flow and ensuring efficient use of parking spaces.

ADVANTAGES OF ANPR

Potential Downsides of Automatic Number Plate Recognition (ANPR) Systems:

- ANPR can be affected by extreme weather conditions such as heavy rain, fog, or snow, which can reduce the accuracy of the system.
- Privacy concerns arise with ANPR as personal data, including license plate numbers, is collected and stored in the system, raising the possibility of misuse or unauthorized access.
- The blurring of photos due to vehicle motion can make it difficult to accurately capture license plate information.
- The accuracy of ANPR can also be affected by low-resolution images, reducing the system's ability to correctly identify and recognize license plates.

V. LITERATURE REVIEW

In March 2011, Yang Guang presented a unique approach to license plate character recognition titled "Wavelet Kernel LS SVM-Based License Plate Character Recognition". The method employs LS-SVM (least square SVM) wavelet kernel and involves two critical steps - preprocessing and multi-classification. The approach involves 4 classifiers based on the wavelet kernel LS-SVM in line with the BT model. The experiment is carried out on the BP neural network and RBF LS-SVM method proposed for this technique. The proposed system achieves a cumulative recognition rate of 98.3 percent, indicating its efficacy in license plate character recognition[2].

In a 2012 paper, Saqib Rasheed introduced a novel method for automated number plate recognition (ANPR) using a combination of Hough lines and template matching. The Hough transformation is used to detect the edges of the license plate, while template matching is employed for number plate identification. The accuracy rate for vehicle plate extraction is reported to be 94.11%, with a correct recognition rate of 90.62% for the identified vehicles. Notably, the proposed ANPR system was designed to work with the standardized number plate format used in Islamabad, Pakistan, and achieved an average result of 89.70%[1].

In June 2014, Dinesh Bhardwaj proposed a method for "Automated Number Plate Recognition using Machine Learning Algorithms" which involved a five-step process. First, the system acquired an image of the number plate, then it pre-processed the image by converting it to grayscale and eliminating noise using a median filter. Next, the system used the Sobel technique for edge detection, followed by vertical segmentation to isolate the characters on the plate. Finally, the K-Star machine learning algorithm was used for character recognition. This method was specifically designed for the Indian ANPR system[3].

In 2014, Sumanta Subhadhira presented a new approach for license plate recognition in their paper titled "License Plate Recognition Application using Extreme Learning Machines." This method involves using a smartphone application to capture an image of a vehicle's license plate, which is then processed and analyzed using a combination of Extreme Learning Machines (ELM) and a Histogram of Oriented Gradients (HOG) feature extractor. ELM is used as a classifier for the license plate recognition process, and it also provides information regarding segmentation. The results of the proposed method show that it can accurately recognize the province part of the license plate with 95.05% accuracy. However, since this part has fewer data to process, it is easier to achieve high accuracy. The proposed method can also recognize the entire license plate, including the vehicle registration identification number and its province, with an accuracy of 89.05%. This suggests that the method is effective at recognizing license plates, but there is still room for improvement in terms of accuracy[4].

In October 2010, M.I. Khalil proposed a Car Plate Recognition system using the Template Matching Method. The LPR device comprises four modules: Image acquisition, licensed plate extraction, segmentation, and recognition of individual characters. However, this system eliminates the need for the segmentation process of the input image using template matching techniques. After the license plate extraction phase, the INFORMATION RECOGNITION PHASE is applied, utilizing the "moving window technique." To recognize the picture and country name, the license plate image serves as the primary image, and the first country image entry is loaded as an object. The shifting window technique is used to detect the object within the image. If the answer is "YES," then the country name corresponding to the country title is retrieved from the country names table. If the answer is "NO," then the next country name photograph is loaded as the object, and this process repeats until the end of the characters. The system's performance yields 90% recognition accuracy[5].

Yoshihiro Shima [2016] proposed a novel method for extracting number plate images based on image category classification using a combination of deep learning and a region

extraction approach. The approach involves morphological photograph processing and deep learning techniques. Morphological photograph processing involves edge detection and connected component analysis (CCA) to extract the region of interest. A pre-trained Convolutional Neural Network (CNN) model, specifically Alex-Net, is used as a feature extractor. The extracted features are then classified using Support Vector Machine (SVM) classifier. The algorithm is implemented in C++ programming language for the morphological photograph processing and MATLAB for the pre-trained CNN and SVM sections. The proposed method is tested on 126 sample images, out of which 113 were successfully extracted as the proper number plate, resulting in a success rate of 89.7%[6].

Kaushik Deba, Md. Ibrahim Khana, Anik Sahaa, and Kang-Hyun Job [2012] proposed a method for vehicle license plate recognition that utilized sliding concentric windows (SCW) for segmentation. The SCW method allowed for the analysis of road images containing vehicles and the extraction of license plate information through the detection of vertical and horizontal edges within the vehicle region. Additionally, they developed an adaptive photograph segmentation approach that utilized the HSI color model for candidate region verification based on hue and intensity, with green and yellow LP and white LP being verified using this method. Their approach primarily focused on an artificial neural network (AAN) algorithm that was based on the Korean number plate system, which ultimately resulted in an 89 percent success rate[7].

Kaili proposed a novel method for license plate classification in August 2018, which is primarily based on convolutional neural networks (CNN). The method utilizes seven layers of CNN, including four convolutional layers and corresponding max-pooling layers, as well as fully connected layers for feature extraction and classification. Finally, the softmax function is applied in the softmax layer for classification. In addition, a faster CNN is employed for localizing the vehicle plate. The proposed method achieves 100% classification accuracy in the training set and a high accuracy of 98.79% in the testing set, demonstrating its effectiveness for license plate recognition[8].

In May 2017, Wei-Chen Liu proposed a novel hierarchical plate recognition system that utilized supervised K-means and Support Vector machines (SVM) to recognize blurred and tilted license plates. The system aimed to reduce the number of character classes within each subgroup and minimize the complexity of SVMs. The primary goal was to achieve high accuracy while minimizing computational complexity. The proposed system achieved an impressive 98.89% precision for recognizing blurred license plates and tilted characters[9].

Zied Selmi proposed a "Deep Learning System for Automatic License Plate Detection and Recognition" in November 2017, which employs a deep learning approach to automate license plate detection and recognition. The study uses a two-stage approach, with the first stage employing a CNN model for LP detection and preprocessing to distinguish between license plates and non-license plates. The second stage uses a different CNN model for license plate classification and recognition. To segment characters, the Canny edge detection approach is utilized, and character recognition is based on the TensorFlow framework utilizing the second CNN model with 37 classes. The dataset used in the study is collected from the Caltech dataset and the AOLP dataset[10].

In March 2017, Alice N Cheeran proposed a method for "Automatic Car Number Plate Recognition". This method utilized a Modified Ant Colony Optimization Algorithm for plate localization during edge detection. The algorithm also employed a Kohonen neural network to classify individual character regions based on their dimensions. The proposed method compared the efficacy of connected component analysis (CCA) and a hybrid network that incorporated CCA. The neural Kohonen network was utilized to perform the CCA, and the accuracy was measured. The proposed algorithm for character segmentation and extraction demonstrated an accuracy of 94 percent[11].

TABLE I. COMPARISON BETWEEN ALL METHODS

S. No	Researchers	Method Used	Year	Accuracy
1	Yang Guang [2]	Mexican wavelet LSSVM	2011	98%
2	Saqib Rasheed [1]	Hough transformation and template matching	2012	89%
3	Dinesh Bhardwaj [3]	Kstar algorithm, Sobel and vertical segmentation	2014	-
4	Sumanta Subhadhira [4]	Extreme learning machines (ELM) and Histogram of oriented gradients (HOG)	2014	89%
5	M.I.Khalil [5]	Information recognition phase and moving window technique	2010	90%
6	Yoshihiro Shima [6]	Morphological image processing, pre-trained CNN, SVM classifier	2016	89%
7	Kaushik Deba [7]	Sliding Concentric Windows and ANN	2012	89%
8	Kaili Ni [8]	Convolutional Neural Network, Faster-CNN	2018	98%
9	Wei-Chen Liu [9]	Hierarchical approach combining K-means and SVM	2017	98%
10	Zied Selmi [10]	Second CNN model, Canny Edge Detection Technique	2017	-
11	Alice N Cheeran [11]	Modified ACO, hierarchical grouped structure, SVM approach	2017	94%

VI. ISSUES AND CHALLENGES IN USING ANPR SYSTEM

Automated license plate recognition (ANPR) systems have revolutionized the field of smart transportation devices, garnering significant interest in recent years. With the aid of ANPR, human intervention in tracking traffic has been greatly reduced. These systems are capable of automatically detecting and recognizing license plates on vehicles, enabling efficient traffic management and facilitating the identification of vehicle owners in metropolitan areas. As the population continues to grow, so does the number of vehicles on the road.

Consequently, there is a pressing need to collect more automobile data and improve traffic management. While several techniques can be used to recognize vehicles, ANPR systems employing image processing protocols offer a highly efficient solution.

Recognition systems are widely utilized for various purposes such as traffic monitoring, electronic toll collection, and law enforcement. These systems also find significant applications in areas such as stolen vehicle recovery, parking lot management, and criminal investigations. However, a major challenge faced by these systems is accurate detection, especially in the presence of varied license plate designs and unfavorable environmental conditions. Poor lighting and low-resolution images further complicate the task of ANPR (Automatic Number Plate Recognition). Moreover, other factors such as tilted or side view images and varying distances of the captured vehicles pose additional challenges in accurate recognition.

Efforts are needed to overcome the challenges of using ANPR in traffic management areas. One crucial step is to implement advanced object detection and recognition techniques that can accurately identify vehicles even in noisy or dirty images. Additionally, automated cleaning techniques for license plate images can improve recognition accuracy.

To achieve higher accuracy in ANPR, researchers must continue to develop and refine image processing methods, as well as explore innovative approaches such as machine learning and deep learning. With the increasing availability of high-performance computing and big data analytics, it is possible to develop more sophisticated and accurate ANPR systems that can handle the challenges of real-world traffic scenarios.

Overall, improving ANPR accuracy is essential for effective traffic management and improved public safety. By addressing the challenges associated with image quality and recognition techniques, ANPR can become a valuable tool for traffic surveillance and management in cities and other urban areas.

VII. Conclusion

The paper highlights the potential of ANPR systems to revolutionize traffic surveillance by automating the recognition of license plates. It discusses various methods for image processing, including the use of Mexico hat wavelet LSSVM, Hough lines, Kstar machine learning algorithm, and hierarchical approaches combining supervised K-means and support vector machine. The study also explores the use of morphological image processing and pre-trained convolutional neural networks for extracting features and classifying images.

The paper emphasizes the importance of accurate license plate recognition in enhancing traffic management and reducing crime rates. By automating the process, ANPR systems can efficiently detect stolen or wanted vehicles and alert law enforcement agencies. The paper also discusses the challenges associated with ANPR systems, including the need for robust algorithms that can handle varying lighting conditions, image quality, and occlusion.

In conclusion, the paper provides a comprehensive overview of the various approaches to license plate recognition in traffic surveillance and highlights the potential of ANPR systems to transform the transportation industry. The study suggests that future research should focus on developing more advanced algorithms that can handle complex image-processing tasks and improving the accuracy of recognition systems.

References

[1] Rasheed, S., Naeem, A., & Ishaq, O. (2012, October). Automated number plate recognition using hough lines and template matching. In Proceedings of the World Congress on Engineering and Computer Science (Vol. 1, pp. 24-26).

[2] Yang, G. (2011, March). License plate character recognition based on wavelet kernel LS-SVM. In 2011 3rd International Conference on Computer Research and Development (Vol. 2, pp. 222-226). IEEE.

[3] Bhardwaj, E. D., & Gujral, E. S. (2014, June). Automated Number Plate Recognition System Using Machine learning algorithms (Kstar). In International Journal of Enhanced Research in Management and Computer Applications, ISSN:2319-7471 Vol.3 Issue 6, June2014, pp:(42-47), Impact Factor:1.147, Available online at: www.erpublications.com .

[4] Subhadhira, S., Jiu Thonglang, U., Sakulkoo, P., & Horata, P. (2014, March). License plate recognition application using extreme learning machines. In 2014 Third ICT International Student Project Conference (ICT-ISPC) (pp. 103-106). IEEE.

[5] M.I.Khalil, Car Plate Recognition Using the Template Matching Method, International Journal of Computer Theory and Engineering, Vol. 2, No. 5, October, 20101793-8201

[6] Shima, Y. (2016, December). Extraction of number plate images based on image category classification using deep learning. In 2016 IEEE International Symposium on Robotics and Intelligent Sensors (IRIS) (pp. 19-26). IEEE.

[7] Kaushik Deba, Md. Ibrahim Khana, Anik Sahaa, and Kang-Hyun Job, An Efficient Method of Vehicle License Plate Recognition Based on Sliding Concentric Windows and Artificial Neural Network, Science Direct, CSIT-2012

[8] Kaili Ni, Meixia Fu, Zhongjie Huang, & Songlin Sun. (2018, August). A Proposed License Plate Classification Method Based on Convolutional Neural Network. In 2018 International Conference on Network Infrastructure and Digital Content (IC-NIDC) (pp. 344-347). IEEE.

[9] Liu, W. C., & Lin, C. H. (2017, May). A hierarchical license plate recognition system using supervised K-means and Support Vector Machine. In 2017 International Conference on Applied System Innovation (ICASI) (pp. 1622- 1625). IEEE.

[10] Selmi, Z., Halima, M. B., & Alimi, A. M. (2017, November). Deep learning system for automatic license plate detection and recognition. In 2017 14th IAPR International Conference on Document Analysis and Recognition (ICDAR) (Vol. 1, pp. 1132-1138). IEEE.

[11] Sasi, A., Sharma, S., & Cheeran, A. N. (2017, March). Automatic car number plate recognition. In 2017 International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS) (pp. 1-6)