Moving Vehicle Registration Plate Detection

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Abstract

Number plates act as the distinctive identify (car) of a vehicle. An image processing-aided real-time plate detecting system eventually finds a solution to the current problem. We presented a real-time vehicle number plate recognition (RVNPR) system in this document to identify number plates. Since the proposed system uses image processing algorithms to extract the characters from the number plates of vehicles passing by a specific location, it does not require the installation of additional hardware, such as GPS or radio frequency identification (RFID). Without a direct human interaction, vehicles are identified by their license plates using sophisticated machine vision technology called license plate recognition. Monitoring, analysis, and follow-up can be done using the vehicle number data offered by this development of an intelligent transportation system. In the last ten years, both the number of cars on the road and in the automotive industry has increased significantly. The better management of vehicular traffic depends on keeping track of vehicles based on their license plates. This study uses a range of methods in each area, from number plate identification to character recognition, in order to maximise system performance with the least amount of effort and utilisation of computer resources.

Keywords— *Artificial Neural Networks,Character Segmentation, Contours, and Optical Character Recognition (OCR)*

I. INTRODUCTION

The current generation of automobiles is widespread around the world. Thus, keeping tabs on automobiles 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. If the characters are not properly separated, character recognition accuracy will be drastically decreased. 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 likely that we will see further developments in this area in the future. 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. 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

The detection of fast-moving vehicles has drawn a lot of attention in the fields of computer vision and image processing. The different algorithms and strategies that have been suggested for identifying and following swiftly moving cars in video frames will be briefly discussed in this literature survey. The use of backdrop subtraction techniques is a typical method for detecting fast-moving vehicles. With these methods, a reference backdrop frame is often created using a Gaussian mixture model or some other statistical technique, and it is then subtracted from the current frame of the video. Following thresholding, the foreground mask is processed to identify and track moving vehicles.

The employment of specialised equipment, such as high-speed cameras and infrared sensors, to take precise pictures of the licence plates even at fast speeds is an alternative method. Though it might be more expensive and difficult to deploy, this can enable more precise number plate detection and recognition.

Other methods that have been suggested for rapid moving vehicle recognition include block-based motion estimates, kalman filtering, and optical flow algorithms. The accuracy of vehicle detection and tracking is frequently improved by combining these algorithms with background removal or deep learning techniques.

Python has seen increasing interest recently for use in detecting fast-moving vehicles. Python is a well-liked programming language for jobs involving image processing and computer vision because of how simple it is to use, how many libraries and frameworks it has, and how well it supports parallel and distributed computing. TensorFlow and PyTorch are just two examples of the several open-source libraries and frameworks that may be used to create and train machine learning models for number plate recognition. To create and enhance machine learning models for this application, these libraries offer a wide range of tools and functionalities. A broad variety of methods and techniques have been suggested as a result of the extensive research and development into the use of Python for rapid moving vehicle detection.

Techniques for background subtraction have been utilised extensively in many different fields, including as surveillance, traffic monitoring, and pedestrian recognition. These approaches' capacity to adjust to changes in the backdrop scene, such as shifting illumination or moving background objects, is one of its main advantages. They may also be susceptible to video noise and artefacts such shadows and reflections, which could result in missed or false detections.

Numerous academics have suggested strategies for enhancing the precision and robustness of background removal algorithms in order to overcome these problems.

These techniques include the use of numerous reference backdrop frames, the incorporation of geographical and temporal information into the background model, and the use of post-processing techniques to remove false positives.

Elgammal et al., for instance, suggested a technique for building a backdrop model using a combination of Gaussian distributions, where each distribution stands in for the intensity of a pixel in the background image. In order to account for changes in the background picture, the mixture model is updated over time. The resulting model is then used to calculate the likelihood that a pixel is in the foreground or background. The probability map is thresholded to produce the foreground mask, which is then used to detect and track moving objects.

The spatial and temporal connections between pixels in the backdrop image can also be captured by using a more complicated background model, such as a Markov random field (MRF). As a result, the background model can adjust to changes in the scene that are more complicated, including occlusions or moving background objects.

For instance, Ramesh et al. suggested utilising connected component analysis to detect and track automobiles in a traffic surveillance system. To create a binary image, the foreground mask is thresholded. Connected components are then recognised and labelled. The classification of each component as a vehicle or a non-vehicle object is then based on the size, form, and location of each component. The vehicle is then tracked over time while its position and orientation are approximated using a Kalman filter. Another strategy is to directly recognise and categorise automobiles in video frames using deep learning methods, such as convolutional neural networks (CNNs). These algorithms can identify and categorise automobiles with a high degree of accuracy because they were trained on vast datasets of annotated vehicle photos.

III.METHODOLOGY

Data has become a precious commodity in our digital age. If certain types of data are left unprocessed, details may be lost. The purpose of this study is to introduce a technique for data extraction from vehicle footage. By analysing this data, law enforcement may be strengthened and the highways can become a safer place. Because the material has been changed from text and video, searching and filtering by terms would be available. Additionally, there is substantially less storage capacity available. This paper's major objective is to describe methods for identifying crucial car attributes from vehicle video. This paper will include a presentation of the solution's design, technological stack, components, and outcomes.

The system's flow is shown in the flowchart below. The system begins by converting the video into frames as an input. Then, if there are any vehicles, each frame is submitted for vehicle detection, and the cropped image is sent for license plate detection. To improve OCR accuracy, each license plate image is pre-processed. After that, OCR is used to extract the license plate text. Following that, logo and color detection are carried out. And the CSV file contains a record of each of these outcomes. Each frame is given for speed detection so that the vehicle's speed can be found, tracked, and displayed to the user.

Last but not least, the user can download the csv file and utilize it for additional analysis. This csv file contains all three parameters—the ID of the car, the speed of the vehicle, and the timestamp with reference to the video.

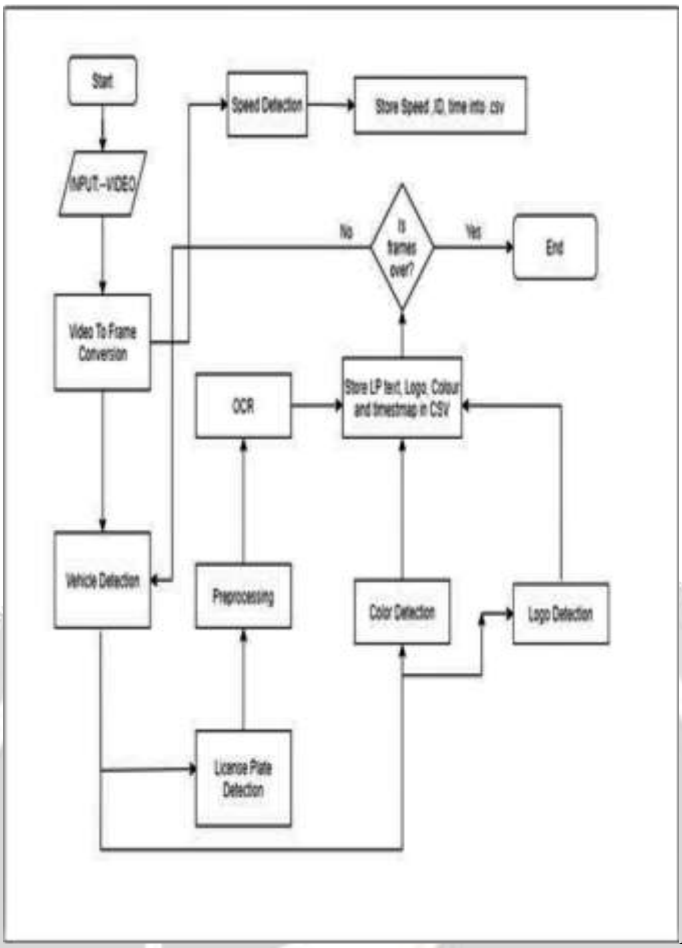

Figure 1: The project's flowchart

A. Image or Video Acquisition

Image/Video acquisition refers to obtaining an image or video from a mobile or digital camera. Images or videos are captured in a variety of lighting and frame configurations. When capturing videos or pictures, distance, weather conditions (winter, smog, rain, summer), and "noise" are all necessary considerations. These photos are RGB-formatted.

B. Image or Video processing

Resizes the data from the plate identification step to a dimension that makes each character stand out and be understood.

Then, convert the colorful image to a greyscale image, which has only one 8-bit channel with values ranging from 0-255, where 0 represents black and 255 represents white, as opposed to the original image's three channels (BGR). This is done to get the image ready for the following step. The threshold function now transforms the grayscale image into a binary image, where each pixel has a value of 0 or 1, with 0 denoting black and I denoting white. Applying a threshold with a value between 0 and 255 in this case results in the resulting binary picture assigning a value of 1 to all pixels in the grayscale image with a value greater than 200. Additionally, any pixels with values lower than 200 will be assigned a value of 0 in the new binary image.

Now that the image is in binary format, the process of eroding may begin. Eroding is a straightforward technique for removing undesirable pixels from an object's boundary, i.e., pixels that should have a value of 0 but do not. It operates by first examining each individual pixel in the image, then examining each pixel's neighbors (the number of neighbors depends on the kernel size). A pixel is only given a value of I if all of its neighbors are pixels with the value 1, otherwise it is given a value of 0.

Dilation is a procedure for improving the structure of an image by filling in gaps, inserting new pixels, and reuniting split lines to sharpen the edge of the image and boost brightness.

The conversion of RGB to grayscale during the pre-processing stage causes some of the original image's information to be lost. The image can be distorted even by noise. By eliminating noise and sharpening edges, dilation is therefore required to improve the transformed image and make it appropriate for edge processing.

The difference in grey value between an object's adjoining pixels grows as the edge becomes sharper. It improves Edge Processing even more. Some essential aspects of an image, such as brightness, light edge, and color difference, may be lost during pre-processing.

These losses can be compensated for by dilation, which also sharpens and brightens the pre-processed image.

Now that the image is clear and devoid of border noise, we will enlarge it to fill in any missing pixels, or pixels with a value of 0 when they should have a value of 1. The function operates similarly to erosion with one important difference: instead of considering each pixel individually, it first considers its neighbors (the number of neighbors depends on the kernel size). A pixel is assigned a value of 1 if at least one of its neighbors is the pixel I. Making the image's borders white is the following step. This will eliminate any out-of-frame pixels that could be present.

Then, in order to filter out the necessary characters, we build a list of dimensions with 4 values with which to compare each character's dimensions.

Our image has been reduced to a processed binary image as a result of the aforementioned procedures, and we are now prepared to submit this image for character extraction.

C. Plate Extraction

The obtained image has irrelevant parts after pre-processing. It is necessary to get rid of the undesired area. For plate extraction, there are numerous methods. The method for plate extraction that is most widely used is edge detection. Many edge detection methods exist, including Roberts and Sobel edge detection.

Figure 2: Plate Extraction

D. Character Segmentation

Each object in the image/video has its own pixel-wise mask thanks to image segmentation. This method enables us to comprehend the object(s) in the image on a much more detailed level. By using a procedure called image segmentation, we may divide up photos into various sections. Contrarily, the contours of an object in an image are the continuous lines or curves that encircle or cover the entire object's perimeter. A contour is an outline that depicts or delimits the form or shape of something.

To extract the components of a picture, we will utilize an image segmentation technique called contours in this case. Additionally, the study of shapes and the recognition of objects both heavily rely on contours.

Additionally, they have a very wide range of applications, including both medical image analysis and image analysis in real-world applications like MRIs.

Following the discovery of all the contours, we take each one into account individually and determine the size of the corresponding bounding rectangle. Take into account that the bounding rectangle is the smallest rectangle that can yet include the contour. Let me draw one for each character in this sentence to demonstrate the bounding rectangle.

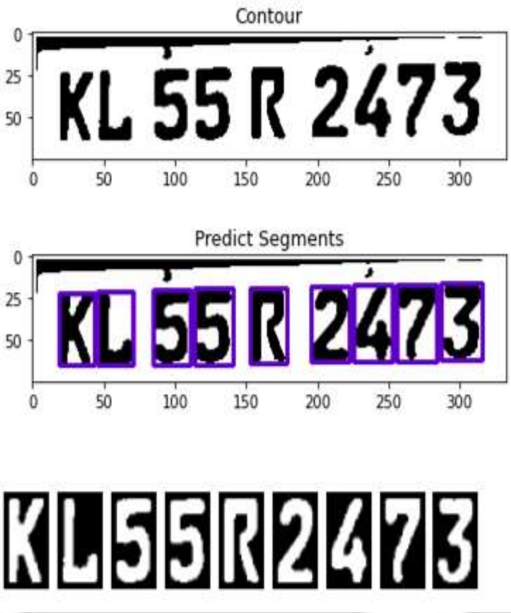

Figure 3: Character Segmentation

E. Character Recognition

The string in the image is converted to a character string using this. Every character is separated from one another by OCR.

One OCR technique uses template matching. That technique involves comparing the cropped image to the template database that already exists. OCR can recognise the characters automatically and without any help from outside sources.

OCR for number plates is less complicated than other techniques since the pattern of the characters in the plate is uniform. Autonomous number plate recognition improves with template matching.

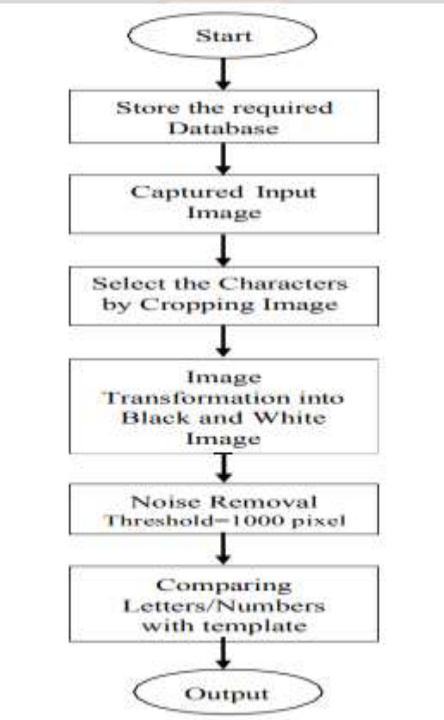

Figure 4: Working of OCR

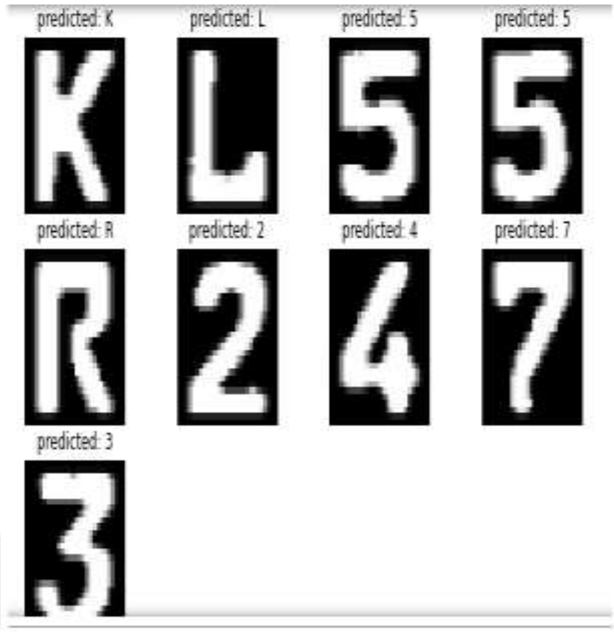

Figure 5: Characters Recognized

IV. RESULTS

We typically conduct our experiment on a number of vehicle prototypes with completely various shapes and dimensions under varying environmental conditions to evaluate the accuracy and method of our approach. The segmentation approach did not generate the intended results for plates at an associated angle and plates near the edge of the picture, which limited the algorithm's accuracy.

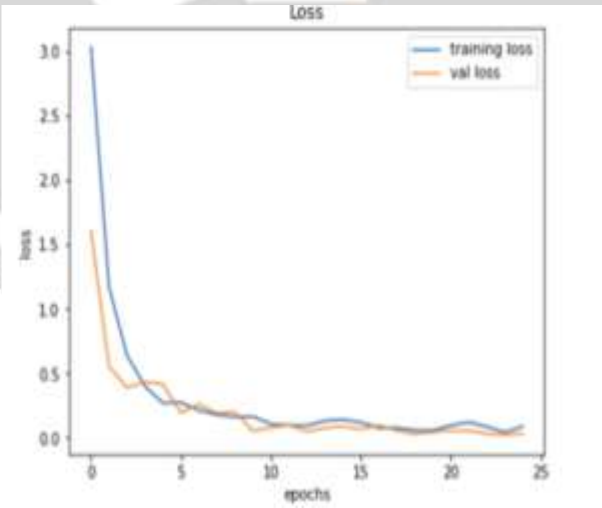

Figure 6: Loss Graph

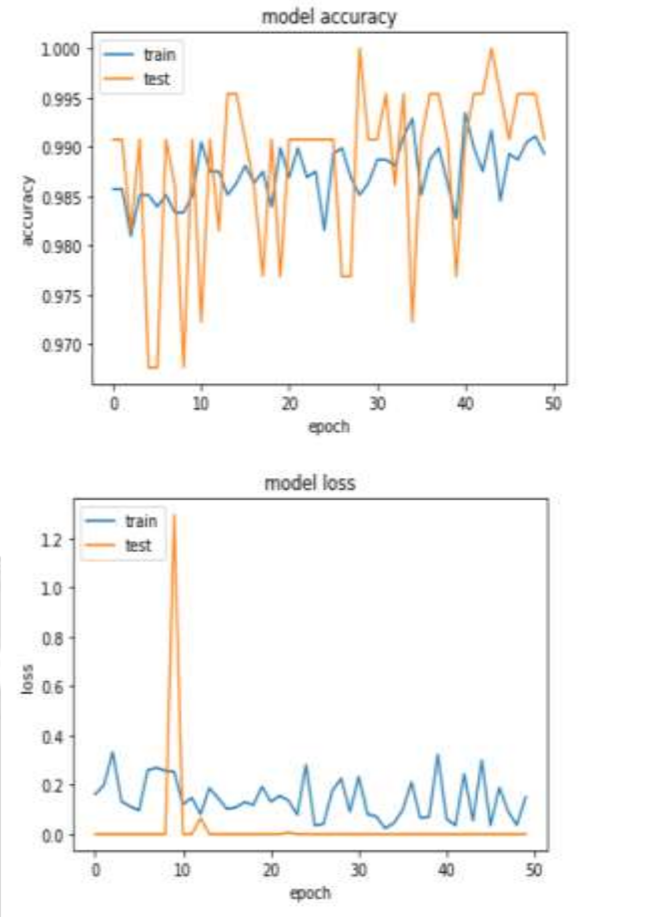

Figure 7: Accuracy Graph

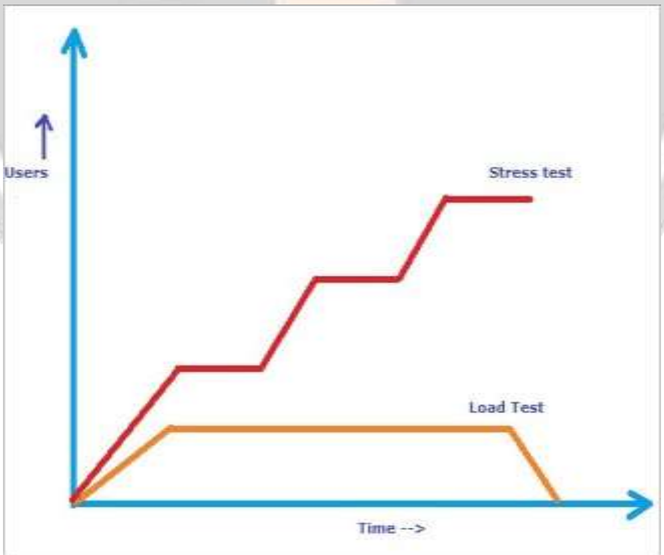

Figure 8: Stress and Load Test

V. CONCLUSION AND FUTURE WORK

In conclusion, our work on automatic number plate recognition is an important and creative solution that has the potential to greatly increase number plate recognition's precision and effectiveness. We have developed a system that can instantly identify license plates of moving automobiles by utilizing computer vision and machine learning algorithms.

By automating the procedure, we want to offer a practical solution that can be included into current hardware and software, hence minimizing the demand for extra resources. The Yolov4 algorithm, which has been demonstrated to be successful in real-time object detection, is the one used by our system. The robustness and adaptability of our system are a result of the algorithm's ability to handle a range of lighting conditions, camera angles, and number plate varieties. The identification of stolen vehicles, the tracking of suspects, and the resolution of crimes are all things that our technology can assist law enforcement authorities with. Community safety and crime rates may increase as a result. Autonomous number plate recognition can also assist parking managers in handling parking violations, keeping track of available spaces, and preventing unauthorised parking. As a result, parking management may become more effective, and parking experiences for customers may be enhanced generally.

There is always opportunity for improvement, despite the great accuracy our technology has demonstrated when detecting number plates. The accuracy of the system can be improved through additional research and development employing more sophisticated machine learning methods and data augmentation.

For increased functionality, our system may be coupled with other technologies like GPS and facial recognition. The system can become more adaptable and efficient in a variety of applications by merging multiple technologies.

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Currently, our technology is made to be used in a stationary location. Creating a mobile application can increase the system's usability and accessibility in many settings. Users can access the system from their smartphones or tablets with the help of a mobile application, making it more practical and adaptable.

Our system currently uses the YOLOv4 algorithm, which has demonstrated great performance in a variety of lighting circumstances, to detect licence plates. In low-light situations, the system's performance can still be enhanced. The system's effectiveness in low-light situations can be improved by creating a more sophisticated algorithm or utilising extra hardware, like infrared cameras.

Our system is built to instantly identify moving vehicle number plates. However, the system can be enhanced to include additional features like detecting the make and model of the vehicle, determining the speed of the car, and detecting other roadside items.

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 onGranular 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 LearningMethods: Review," 2021 11th IEEE InternationalConference on Control System, Computing andEngineering (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.