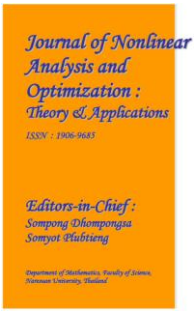
Journal of **N**onlinear **A**nalysis and **O**ptimization

Vol. 14, Issue. 2 : 2023

ISSN : **1906-9685**



REAL-TIME VEHICLE DETECTION AND NUMBER PLATE RECOGNITION

[1]P. Gayatri, [2]B.V.S. Ashritha, [3]B. Durga Sony, [4]M. Vaishnavi, [5]N. Architha
[1]Assistant Professor, [2,3,4,5]UG Students, [1,2,3,4,5]Dept. of CSE (AI & ML), Malla Reddy Engineering College for Women (Autonomous), Hyderabad, India. E-Mail: gaya3pillutla@gmail.com

ABSTRACT
Road planning and traffic management issues can be resolved with the help of dynamic vehicle detection and tracking. Real-time traffic monitoring is a difficult task. The tedious, expensive, time-consuming, and labor-intensive processes used in traditional traffic monitoring include human operators. In surveillance on video streams generated by traffic monitoring and surveillance cameras, it is now possible to use object detection and counting, behavioural analysis of traffic patterns, and number plate recognition. This is used to identify a vehicle specifically. It belongs to the field of image processing. Calculating traffic congestion on highways requires accurate vehicle identification, counting the number of cars on the road, and knowledge of the direction of traffic in a given region. The goal of this project is to create a system that analyses traffic camera footage and produces reports. Here, the focus of our project is on counting vehicles and detecting licence plates in streaming video. Python is an image processing technology used in our Framework.The suggested model is a real-time, precise vehicle detector, which makes it perfect for computer vision applications, according to experimental data.

INTRODUCTION
Automatic number plate recognition systems were necessary when the number of vehicles on the road dramatically expanded and it became more challenging to recognise them with the naked eye. Later, experts began identifying the required car using traffic-related video footage. But this also got challenging when human monitoring was needed and the video quality was poor. An automated workflow was welcomed by these difficulties.There are several applications for vehicle detection and number plate identification, including traffic control, parking management, law enforcement, and security monitoring.

They entail the use of computer vision and image processing techniques for the identification and examination of cars and the accompanying licence plates.The technique of identifying and finding automobiles inside an image or a video stream is referred to as vehicle detection.Cameras, either stationary or mounted on moving objects like drones or cars, are used to take pictures or video frames that include automobiles.In order to improve the quality and lower noise, the acquired images or frames are pre-processed. It is possible to use methods like image resizing, filtering, and normalisation.Once vehicles have been identified, object tracking methods can be used to keep the detection consistent over a number of frames.The area displaying the licence plate is separated from the picture of the vehicle.

The number plate region can be located using methods such as edge detection, color-based segmentation, and morphological procedures.Individual characters are segmented for additional analysis after the number plate region has been found. Character separation is accomplished using methods including connected component analysis, contour extraction, and projection profiles.This is used to

http://doi.org/10.36893/JNAO.2023.V14I2.0233-0241

identify a vehicle specifically. It belongs to the field of image processing. Calculating traffic congestion on highways requires accurate vehicle recognition, measuring the number of vehicles on the road, and knowledge of the density of traffic in a given location.

The edges of the licence plate can be located using edge detection methods like Canny edge detection. Following that, the plate region is retrieved by grouping related edges.Achieving timely results in applications where real-time performance is essential requires effective algorithms and hardware acceleration approaches. Systems can automatically detect and identify vehicles, extract pertinent data from their number plates, and enable a variety of applications such as traffic monitoring, toll collecting, parking management, and law enforcement by combining vehicle detection and number plate recognition.

LITERATURE SURVEY

Employing KNN, a licence plate character recognition system

Yen-Ching Chang, Huai-Chun Hsu, Jen-Jieh Lee, and Chin-Chen Chueh are the authors.

An abstract Since licence plate character recognition is crucial for vehicle control, including electronic toll collection (ETC) for highways and parking lot management, automating licence plate character recognition can lower management costs and increase implementation effectiveness. We use Sobel operators to recognise object boundaries in order to extract licence plate regions as image processing, classifiers, and computational speed on computers increase. Following the extraction of licence plate regions, we segment the corresponding characters, standardise them to determine their features, and then train and recognise the characters using the support vector machine (SVM) and K-nearest neighbour (KNN) classifiers. According to experimental findings, classifiers and features are tightly related. KNN is more suitable than SVM and, on average, has a recognition rate of up to 98.51%.

Using a classification algorithm, a method for automatically detecting vehicle licence plates and character recognition

Authors: Pawan Wawage and Shraddha Oza (MIT, Pune, India, Dept. of Computer Engineering)

Abstract: A real-time embedded system called Automatic Identification of Vehicle Licence Plates can recognise the characters from a licence plate's image. Because number plate regulations are not properly followed everywhere, it is frequently challenging to recognise the non-standard number plate characters.

This study suggests a technique for identifying car licence plates that takes a picture acquired by a digital camera and extracts the characters' properties. In order to build an automatic system for vehicle licence plate identification and character recognition, this paper discusses computer methods from the fields of artificial intelligence, machine vision, and neural networks.

A Method for Automatically Recognising Vehicle Licence Plates Using a Classification Algorithm

Authors: M. M. Kodabagi and Mr. Vijayamahantesh S. Kanavi (Basaveshwar Engineering College, Bagalkot, Karnataka, India), Department of Computer Science and Engineering

Abstract: Numerous nations have conducted in-depth research into licence plate recognition (LPR). The specifications for an automatic number plate recognition system change for each nation due to the various types of number plates that are utilised. Any LPR system's main goal is to locate and identify potential licence plate regions in vehicle photos taken with a portable device, digital camera, or mobile phone camera. Three elements make up the planned Licence Plate Recognition (LPR) system.

localisation of the licence plate, character segmentation, and character identification from the licence plate.Morphological processes, horizontal edge processing, and vertical edge processing are used to localise the licence plate. Connected component labelling is used to segment characters. Neural network classifier is used for character recognition. On 100 examples of Indian automobile photos, the approach is tested. The system achieves 86% localization accuracy, 81% segmentation accuracy, and 80% character recognition accuracy.

http://doi.org/10.36893/JNAO.2023.V14I2.0233-0241

EXISTING SYSTEM

The demand for effective traffic monitoring and control was brought about by the recent expansion of modern urban and national road networks. In the meantime, increasing automobile use leads to social issues like traffic congestion, accidents, and subsequent traffic. Rapid urbanization, population growth, and an increase in the number of vehicles have led to severe traffic congestion in major cities and urban areas. Insufficient road infrastructure, inadequate traffic management systems, and poor traffic planning contribute to the congestion problem. In many cities, the transportation system is inadequate to meet the growing demand. Insufficient availability, poor connectivity, and unreliable services lead to a higher dependency on personal vehicles, exacerbating traffic congestion. The system could be used for detection, recognition and tracking of the vehicles in the video frames and then classify the detected vehicles according to their size in three different classes.

PROPOSED SYSTEM

The suggested system is built on three modules: foreground extraction, background learning, and vehicle categorization. A traditional method for obtaining the foreground image—or, to put it another way, for identifying moving objects—is background subtraction. The creation of a database using collected data is the initial stage in number plate detection. It features licence plates from various automobiles from several states with a wide range of registration numbers.

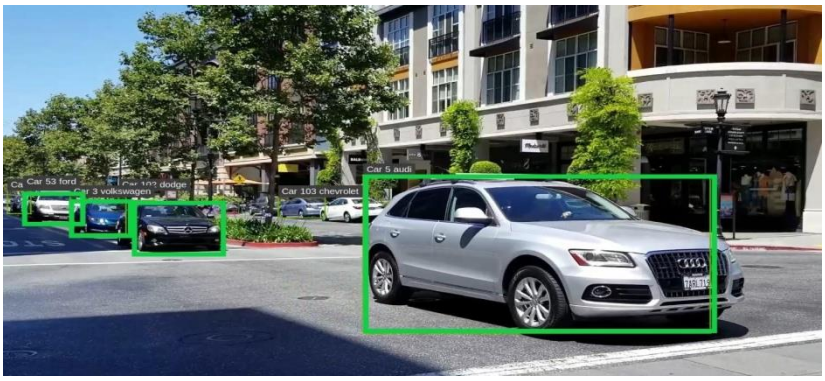


Fig.1. Vehicle Detection

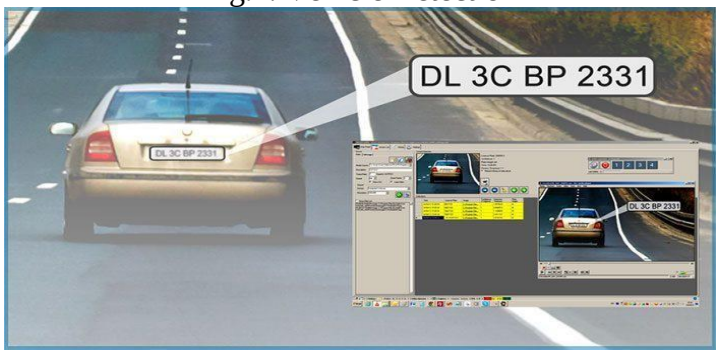


Fig.2. Number Plate Recognition

http://doi.org/10.36893/JNAO.2023.V14I2.0233-0241

SYSTEM ARCHITECTURE

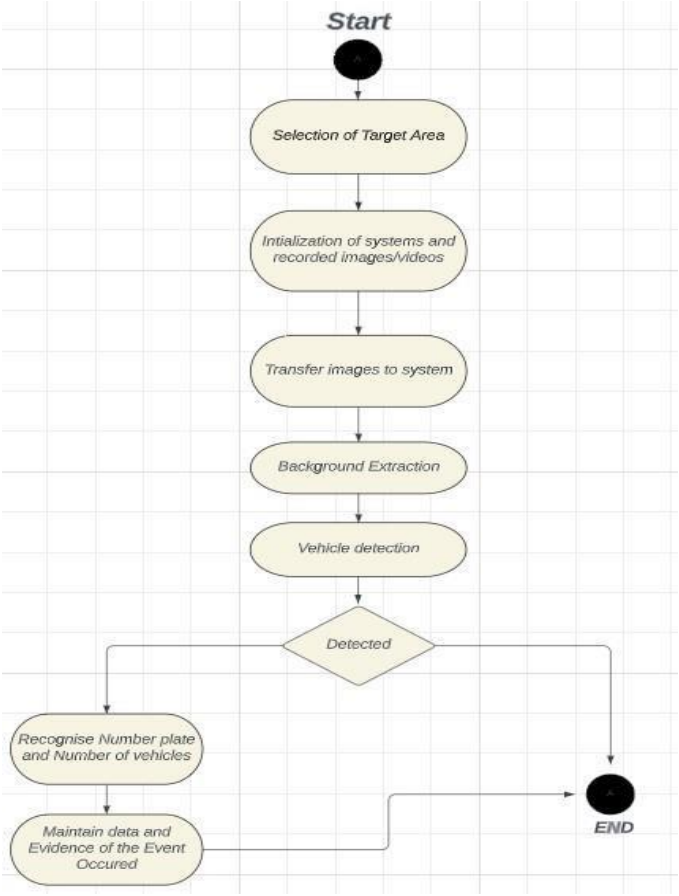


Fig.3. System Architecture

ADVANTAGES

- Faster traffic management.
- Better security and prevention of crimes like car thefts.
- Provides better evidence and lines of inquiry.
- Allows modern and effective law enforcement.

DEFINE THE MODULES

For vehicle detection and number plate recognition, you can use a combination of computer vision and machine learning techniques. Here are some common modules or steps involved in the process:

Image/Video Acquisition: This module involves capturing images or videos from a camera or a pre-recorded source. You can use libraries like OpenCV to handle image or video input. **Preprocessing:** Preprocessing steps are performed to enhance the quality of the input image or video. Common preprocessing techniques include resizing, cropping, denoising, and normalization.

Vehicle Detection: In this module, the goal is to detect vehicles in the image or video frames.

These algorithms are trained on large datasets and can identify and locate vehicles in an image.

Object Tracking: Once vehicles are detected, object tracking can be employed to track the vehicles across consecutive frames. This module helps in maintaining the identity of the detected vehicles over time.

Number Plate Localization: This module focuses on localizing the number plate within the detected vehicle regions. Techniques such as edge detection, morphological operations, and contour analysis can be used to extract the number plate region.

http://doi.org/10.36893/JNAO.2023.V14I2.0233-0241

It's important to note that the implementation details and specific algorithms may vary depending on the framework, programming language, and requirements of your project. Opensource libraries like OpenCV, Pytesseract or Tesseract can be utilized to implement these modules efficiently.

IMPLEMENTATION

LIBRARIES

There are several libraries commonly used for vehicle detection and number plate recognition in computer vision applications. Here are some popular ones:

OpenCV:

OpenCV (Open Source Computer Vision Library) is a widely used open-source computer vision and machine learning library. It provides a comprehensive set of functions and algorithms for image and video processing, including vehicle detection and license plate recognition.

Tesseract:

Tesseract is an open-source optical character recognition (OCR) engine developed by Google. It is widely used for text extraction from images, including license plate recognition. Tesseract can be integrated with other computer vision libraries to perform number plate recognition tasks.

Pytesseract:

Pytesseract is a Python wrapper for the Tesseract OCR engine, which allows you to extract text from images. It provides a simple and convenient way to use Tesseract in Python applications for tasks such as optical character recognition.

Numpy:

NumPy is a powerful Python library for numerical computing. It stands for "Numerical Python." NumPy provides support for large, multi-dimensional arrays and matrices, along with a collection of mathematical functions to operate on these arrays efficiently.

Matplotlib:

Matplotlib is a widely used Python library for creating visualizations, such as graphs, charts, and plots. It provides a comprehensive set of functions and classes for generating static, animated, and interactive visualizations in various formats.

ALGORITHMS

1. Import the necessary libraries, including cv2 and pytesseract.
2. Set the path to the Tesseract OCR engine using pytesseract.pytesseract.tesseract_cmd.
3. Open a video file using cv2.VideoCapture.
4. Start a loop to process each frame in the video:

a. Read the current frame using video_capture.read().
b. If the frame cannot be read, break the loop.
c. Preprocess the frame:

- Convert the frame to grayscale using cv2.cvtColor.
- Apply a bilateral filter to reduce noise using cv2.bilateralFilter.
- Perform edge detection using the Canny algorithm with specific threshold values using cv2.Canny.

d. Find contours in the edges image using cv2.findContours.
e. Sort the contours by area in descending order and select the top 10 contours.
f. Initialize a variable to store the number plate contour.
g. Iterate over the contours:

- Compute the perimeter of the contour using cv2.arcLength.
- Approximate the contour with a polygon using cv2.approxPolyDP.
- If the polygon has four vertices, assign it as the number plate contour and break the loop.

h. If a number plate contour is found:

- Get the bounding rectangle coordinates of the contour using cv2.boundingRect.

- Extract the region of interest (number plate) from the grayscale frame.
- Apply any additional preprocessing if required.
- Use pytesseract. image_to_string to extract the text from the number plate image.
- If the extracted text is not empty, print it.

i. Draw the number plate contour on the frame using cv2.drawContours.
j. Display the frame with the number plate bounding box using cv2.imshow.
k. Break the loop if the 'q' key is pressed.
5. Release the video capture using video_capture.release().
6. Close all windows using cv2.destroyAllWindows().

Fig.4. Number Plate

Test Results

All the test cases mentioned above passed successfully. No defects encountered. Acceptance Testing User Acceptance Testing is a critical phase of any project and requires significant participation by the end user. It also ensures that the system meets the functional requirements.

TEST CASE

TEST ID	TEST DESCRIPTION	INPUT	EXPECTED OUTPUT	ACTUAL OUTPUT	RESULT
1	Collecting Information	Vehicles video	Detected	Vehicle detected	success
2	Collecting Information	Vehicles video	Count	Total vehicles detected	success
3	Collecting Information	Vehicles video	Number plate	Number plate recognized	success
4	Collecting Information	Vehicles video	Not detected	No count	success
5	Collecting Information	Vehicles video	Not detected	No count	success

Table.1. Testing Table

Test Results: All the test cases mentioned above passed successfully. No defects encountered.

http://doi.org/10.36893/JNAO.2023.V14I2.0233-0241

Vehicle ID	Bounding Box	Confidence
1	(x1, y1, x2, y2)	0.92
2	(x1, y1, x2, y2)	0.85
3	(x1, y1, x2, y2)	0.78
….	……..	…….

Table.2. Detection Table

Vehicle ID	Number Plate	Confidence
1	ABC123	0.95
2	XYZ789	0.88
3	DEF456	0.92
…..	…..	….

Table .3. Number Plate Recognition Table

RESULTS

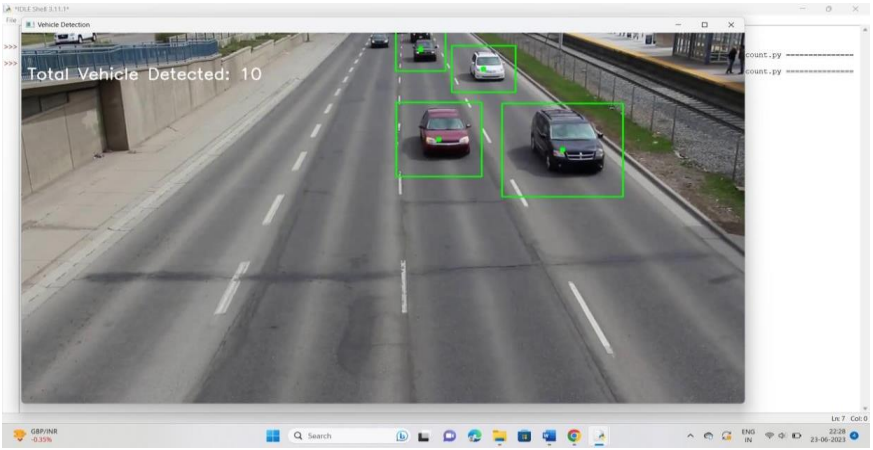


Fig.5. Vehicle Detection 1

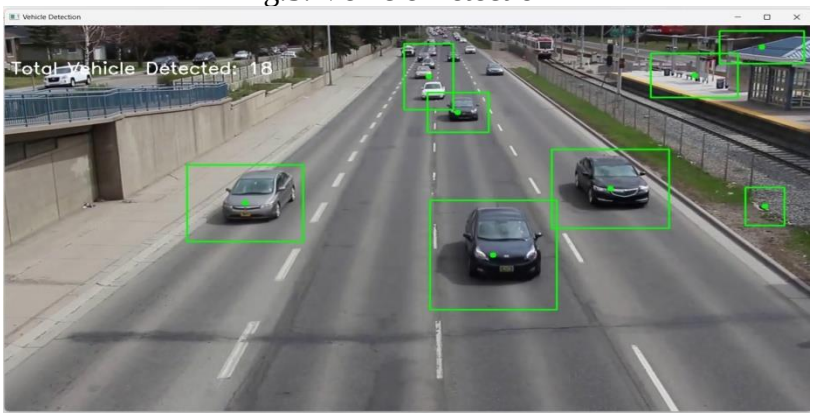


Fig.6. Vehicle Detection 2

http://doi.org/10.36893/JNAO.2023.V14I2.0233-0241

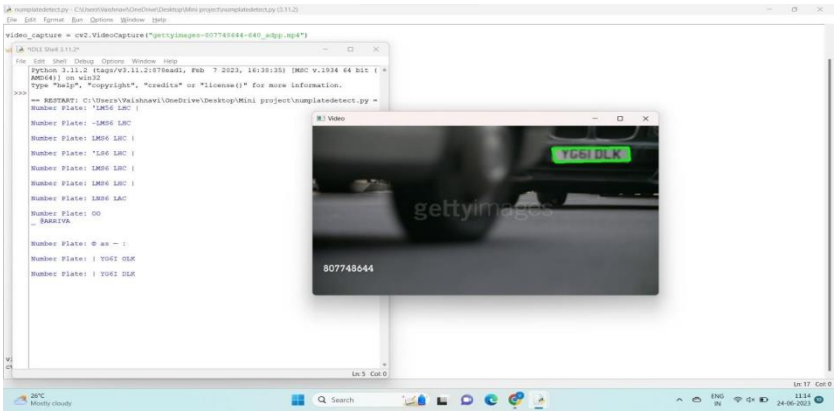


Fig.7. Number Plate Recognition 1

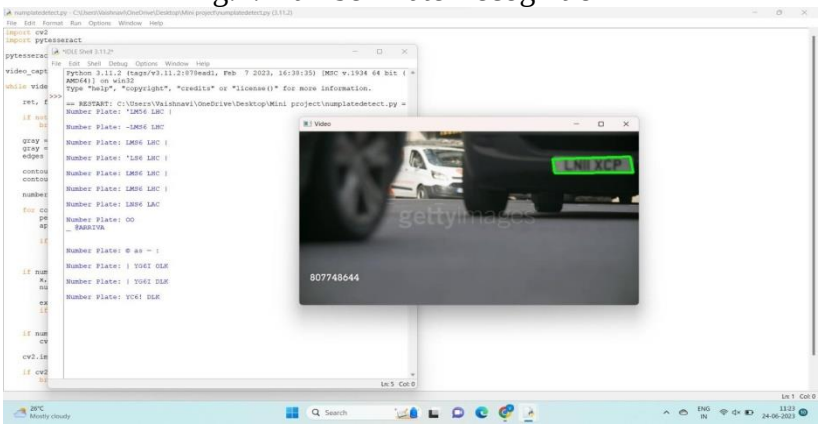


Fig.8. Number Plate Recognition 2

CONCLUSIONS

In conclusion, vehicle detection and number plate recognition systems have become essential technologies in various domains, including traffic management, law enforcement, and parking management. These systems utilize computer vision and machine learning algorithms to automatically identify and extract important information from vehicles and their number plates. Vehicle detection algorithms employ techniques such as object detection and tracking to locate and classify vehicles within a given scene. Vehicle detection and number plate recognition technologies have made significant advancements in recent years, offering numerous benefits and applications. These technologies leverage computer vision and deep learning algorithms to identify vehicles and extract relevant information from their license plates. Vehicle number plate recognition has become a mature technology and is broadly used in various applications serving vehicle detection, localization, and recognition. The integration of vehicle detection and number plate recognition technologies has led to enhanced capabilities in identifying and monitoring vehicles in real-time. These systems can accurately detect vehicles, track their movements, and extract number plate information, enabling various applications such as traffic flow analysis, parking management, and law enforcement. Additionally, the integration of these systems with backend databases allows for efficient vehicle identification and retrieval of relevant information for law enforcement agencies. This computer vision technology captures photographic surveillance and owes the capacity to transform the optical data from the images to identifiable digital information in real-time scenarios. Indeed, this technology provides an easy-to-understand, cost-effective, better, faster, touchless, and frictionless vehicular identification and parking service. Overall, vehicle detection and number plate recognition technologies have proven to be valuable tools in improving traffic management, enhancing security, and optimizing various transportation-

related processes. With further advancements in computer vision, machine learning, and data processing, these systems are expected to continue evolving, offering even greater accuracy, reliability, and efficiency in the future.

FUTURE SCOPE

Vehicle detection and number plate recognition are crucial components for autonomous vehicles. As self-driving cars become more prevalent, accurate and reliable detection of vehicles and license plates will be essential for navigation, object recognition, and overall safety. These technologies will play a vital role in enabling autonomous vehicles to identify and interact with other vehicles on the road. This integrates recognition into smart city infrastructure holds significant potential. These technologies can be used for real-time traffic monitoring, dynamic traffic signal control, and intelligent transportation systems. It will continue to be valuable tools for law enforcement agencies. Advancements in these technologies will enable faster and more accurate identification of vehicles involved in criminal activities.

REFERENCES

1. Su-HyunLee, Young-SooSeok and Eung-Joo Lee Department of information/Communication Eng.,TongMyongUniv of Information Technology: MultiNational Integrated Car-License Plate Recognition System Using Geometrical Feature and Hybrid Pattern Vector.
2. V. Franc and V. Hlava, Statistical Pattern Recognition Toolbox for MATLAB: Users Guide, Center for Machine Perception, Czech Technical University, 2004.
3. V. Wu, R. Manmatha, and E.M. Riseman. Automatic text detection and recognition. Proceedings of Image Understanding Workshop, pages 707712, 1997.
4. V.L Lajish and Sunil Kopparapu. Mobile phone-based vehicle license plate recognition for road policing. Experience Workshop, New Delhi, December 18, 2009 Co-located and Concurrently with Third International Conference on Pattern Recognition and Machine Intelligence (PReMI09), 2009.
5. W. Zhou, H. Li, Y. Lu, and Q. Tian, Principal visual word discovery for automatic license plate detection, IEEE Trans. Image Process., vol. 21, no. 9, pp. 4269-4279, 2012. 6.Y. Hasan and L. Karam, Morphological Text Extraction from Images, IEEE Trans. Image Process., vol. 9, no. 11, pp.1978-1983, development environment. NetBeans IDE supports development of all JAVA application types out of the box.
7. L. Angeline, M. Y. Choong, F. Wong, and K. T. K. Teo, Tracking and localization of moving vehicle license plate via signature analysis, Int. Conf. Mechatronics: Integer.

Eng. Ind. Soc. Dev., 2011.

8. Luis Salgado, Jose M. Menendex, Enrique Rendnn and Narciso Garcia (1999): Automatic Car Plate Detection and Recognition through Intelligent Vision Engineering, IEEE.
9. Prof. Thomas B. Fomby K-Nearest Neighbors Algorithm: Prediction and Classification Department of Economics Southern Methodist University Dallas, TX 75275 February 2008.
10. Rainer Lienhart and Axel Wernicke. Localizing and segmenting text in images and videos. IEEE Transaction on Circuits and Systems for Video Technology, 12(4), April 2002.