



REPUBLIC OF TURKEY  
ALTINBAŞ UNIVERSITY  
Institute of Graduate Studies  
Information Technologies

**SMART DETECTION SYSTEM OF VEHICLES  
LICENSE PLATE BY USING SEGMENTATION  
AND ENHANCEMENT IMAGE TECHNIQUE**

**Omar Jamal Kamil KAMIL**

Master's Thesis

Supervisor

Prof. Dr. Osman UCAN

Istanbul, 2022

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2022

The thesis titled SMART DETECTION SYSTEM OF VEHICLES LICENSE PLATE BY USING SEGMENTATION AND ENHANCEMENT IMAGE TECHNIQUE prepared by OMER JAMAL KAMIL KAMIL and submitted on 20/05/2022 has been **accepted unanimously** for the degree of Master of Science in Information Technology

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I hereby declare that all information/data presented in this graduation project has been obtained in full accordance with academic rules and ethical conduct. I also declare all unoriginal materials and conclusions have been cited in the text and all references mentioned in the Reference List have been cited in the text, and vice versa as required by the abovementioned rules and conduct.

Omar JAMAL KAMIL

Signature

## **DEDICATION**

According to dedicate partition, the journey will not accomplish without my parents, my brothers, my sisters, my advisor and who gave me his/her time and support to achieve this work.



## **PREFACE**

According to the preface, this work submitted as a gift to my main advisor Prof. Dr. Osman UCAN for his time and advice.



## ABSTRACT

# SMART DETECTION SYSTEM OF VEHICLES LICENSE PLATE BY USING SEGMENTATION AND ENHANCEMENT IMAGE TECHNIQUE

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Nowadays the image recognition technique is become more popular and interest due to its facility in utilize feature detection in addition to that, the detection is most significantly important with the introduced Convolutional Neural Network known as CNN, the idea save the cars from the stealing missions with a character segmentation to recognize the cars numbers using License Plate Recognition System, many layers of pooling had applied to solve the recognition system with the transfer learning to detect the Iraqi provinces cars names, according to the classification cities were applied are Erbil, Duhok, Suleimani with the cars plates initially from zero up to nine, this work had implemented and executed using Java software.

**Keywords:** Vehicle Number Plate Recognition, Computer Vision, Convolutional Neural Network, Cars Plates, Java Software.

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## ABBREVIATIONS

VNPR : Vehicles Numbering Plates Recognize.

LP : License Plate.

LPS : License Plate System.

CNN : Convolutional Neural Network.

TC : Traffic Control.

RS : Recognition System.

IRF : Image Recognition Framework.

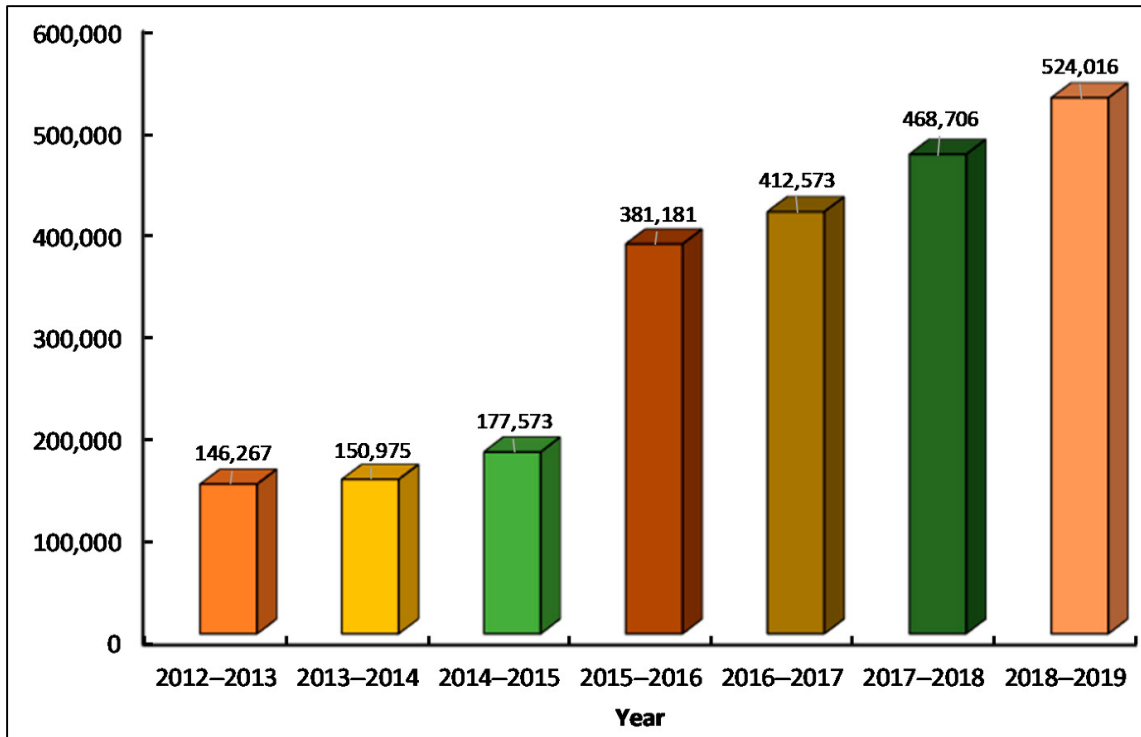
AI : Artificial Intelligent.

RPN : Recognition Plate Number.

# 1. INTRODUCTION

Vehicles Numbering Plates Recognize (VNPR) could be original and effective researching method on computers visions. detection in real-time be used to handle this challenge in a realistic and effective manner It is important to collect number plates from stationary automobiles as well as from moving automobiles to monitor traffic systems. but also, for the purpose of enforcing traffic regulations. However, progress is being made. Because of the advancement of Application in autonomous driving and transportation systems, automated transportation systems are becoming increasingly significant. The detection and identification of late (LP) is of critical importance. Even though LP detection has been a significant challenge, the work continues to confront various challenges in various research investigations over the decades. Problems arising from the emergence for newest technology like the unmanned drive, IoT and biggest data, and so on profound understanding as a result, a re-evaluation of the problem and potential remedies is required. There is no need to involve prior limitations. Most of the currently available approaches for detecting LP are photos and videos are created under strict guidelines [1]. with the rising number of automobiles on the road, traditional systems of monitoring and regulation are becoming increasingly problematic. (For example, traffic police monitoring, and manual monitoring.) An intelligent system can do the following, detection in real-time be used to handle this challenge in a realistic and effective manner It is important to collect number plates from stationary automobiles as well as from moving automobiles to monitor traffic systems. but also, for the purpose of enforcing traffic regulations. However, progress is being made.[2] Authorization can be aided by recognizing auto number plates (e.g., when a vehicle enters an impermeable premise). The VNPR is creating a security policy at the same time. The significance of the issues has grown. The purpose of this research is to detect and recognize vehicle number plates. in an ingenious approach the tests were carried out on autos in Dhaka, Bangladesh, among other places. However, the mission might be expanded to any country. Dhaka has a diversified population and is densely inhabited. There's a lot of traffic, and individuals constantly disobey the law. Bangladesh is a country in the process of evolving [3] The number of vehicles in Bangladesh is rapidly increasing each year as shown below in figure 1.1. This might explain the increased number of road accidents and deaths. The Bengali script and numerals are used in Bangladeshi. Automobile license plates the international

automobile registration code for Bangladesh is BD. In Bangladesh, two types of vehicles are used: civil automobiles and army vehicles.



**Figure 1.1:** Number of Vehicles Registration Shown in Histogram for Bangladesh Country.

There is a need to reconsider the problem and the solution without prior constraints. The most current LP detection methods on figures additionally video is performed in certainly limited environment. These interesting regions could be first like constraints, like this LP that supposed until become localize on these regions for these tested captures. cameras settings with lighting condition were others generally accepted restrictions. In practical applications, a fixed camera is often used, while lighting conditions are considered high visibility conditions. The aspect ratio, orientation, and color swatches of the page size also reduce problem areas. In addition, prior knowledge of the various functions of LP allows us to design simple solutions that take advantage of the real-time performance of the system. As our goal is to redefine LP sensing to meet future challenges from system automation, the constraints need to be modified or relaxed to create a functional viability solution. these examples when significantly for these restrictions were violates it the mobiles trafficable monitor systems that required robust, accurately with fasting LP detect.

Other programs situated could be this LP is partial visibility and obscure, thus making detection difficult. Especially if detect use for mask these identities for the vehicles to protect privacy through real time broadcasts, there will not be remained times with margins to errors on detect. This example show the LP detect it the complexes issues with these requires highest accurately. Also, this ROI on these examples recommended above for dynamical with this LP it won't be in the fixing coordinates on this figure capturing. The faster detection speed is one of the advantages of edge-based approaches. However, owing of their sensitivity to undesirable edges, we don't employ them on complicated photos. Furthermore, It will be tough to find LPs if they are fuzzy. based on color approaches locate the colors of the LPs in the image to identify them Color model classifier Xie One et al. [9] and Zayed et al. [front]. Additionally, the authors of [11] used segmentation algorithms to segment color images. In fact, these niches are determined using a combination of rectangular features, aspect ratio, and stroke density. To deal with such problems, the authors proposed a way to dim the light variations. Judgment is required for LP color detection. Actually, LP is the best example. Extracting color information can detect slashes and LPs with distorted sound. This thesis describes the research studies on the application of image segmentation to the license plate classification and recognition system for IRAQ license plates. License plate recognition (LPR) is an image processing technology used to identify vehicles based on their license plates. LPR is a form of Intelligent Transportation System (ITS) technology that not only recognizes and counts vehicles, but also uniquely distinguishes each vehicle. With the spread of information technologies, smart transportation systems are gaining more and more importance in traffic management. LPR frameworks have an incredible imperative to recognize rush hour traffic congestion, traffic signs, vehicle tracking, containment, vehicle release mechanization, cost classification frameworks, electronic fees, and a host of other applications [12]. This innovation is emphasized in security and transport organizations. The idea of innovation now hopes that all vehicles will have the displayed character (plate), so no additional transmitters or feedback units should be added to the vehicle. For some applications, such as electronic expense classification and red-light violation authorization, the LPR stores the alphanumeric value of the card so that vehicle owners can be investigated for expenses or money. In commercial vehicle operations or other operations such as secure access control, the vehicle's label is checked against the OK dataset to decide whether the vehicle can pass through the checkpoint or enter an enclosed area or a local

parking lot. LPR can be used to penalize speeding drivers or, on the other hand, to provide up-to-date information to speeding drivers by displaying the license plate along with the speed of the vehicle above. When it comes to the alphanumeric grouping of a license plate, it can work with a diffusion test by naturally checking for dirt in the exhaust, or it can help detect and punish violators. LPR can also display the time it takes for vehicles to travel from one point to another, keeping traffic informed about travel times along congested roads and highways. At border crossings around the world, the main general vehicle identifier can be checked against the knowledge base of hot "vehicles" to find vehicles and license plates taken or those registered to thugs, vagrants or those carrying suspects on the other hand. LPR is also referred to in different references:

- a. Automatic Vehicle Identification (AVI).
- b. Plate recognition (CPR).
- c. Automatic license plate recognition (ANPR).
- d. License plate reader (CPR).
- e. Optical character recognition (OCR) for cars.

LPR units are based on front and back plate images. The LPR unit will examine the overall figure frame via this infrared illuminator with cameras units and it broke down and perceived naturally. Since the vehicle plates depend on various country guidelines, they are generally divergent in structure, shape and material. Accordingly, the LPR frameworks can be nation explicit and are adjusted to the nation where they are introduced and utilized. the fewest plates having addition data composing or connected for these plates, for example, status recognizable proof, territory initials, plate issue date mark, vehicle type, Country banner, and the sky is the limit from there. For most applications this extra data isn't needed furthermore, it is normally not distinguished because of the intricacy, variety, quality and goal. The LPR dissects the picture with various picture handling calculations, improves the picture, recognizes the plate position, extricates the plate string, and distinguishes the textual styles utilizing exceptional man-made brainpower strategies like Brain Organizations, design examination procedures, etc. LPR has a wide scope of uses, where

the extricated plate number and discretionary pictures are utilized to make mechanized answers for different issues. These incorporate the accompanying the applications.

- a. Parking plates are used to identify prepaid persons and to determine the cost of parking for non-individuals (considering exit and transit times). An image of the driver's face may be used, possibly optionally, to avoid the capture of a vehicle. Year
- b. B.C. The number of border control vehicles registered at the office or exit is also used to scan road junctions. It can also reduce long factory queues by reducing the line routing time required to return. Year
- c. Vehicle theft Penalties for theft or non-recovered vehicles are used to draw attention to a passing 'hot' vehicle. The "boycott" can be extended gradually and the police can be reported immediately.
- d. LPR officers were brought to the curb and played a permanent match between overtaking and destroying vehicles. When a match is observed, an alarm or protest is triggered, and police are notifying for this vehicle detect with this reason to make stop.
- e. Enforcement - the plate number is utilized to deliver an infringement fine on speed or red-light frameworks. The manual course of setting up an infringement fine is supplanted by a mechanized processing while diminishes this upward with completion times. This fine could see with POL.
- f. Traffic control - these vehicles can be coordinated to various paths as indicated by their section licenses. The framework successfully decreases gridlocks and the quantity of orderlies.
- g. Digital signage marketing tools can be used to gather analytical information about repeat visitors or to aggregate traffic profiles for the ultimate goals of advertising (for example, repeated hourly segments or daily).
- h. Travel - various license plate recognition units were introduced on various areas on cities courses also, this VNPR were matching via these focuses. This typical fast also, travels times

during those focuses could become determined with introduced for screen city trafficable ways. Moreover, this typical fasting might become utilized for give the fasting tickets.

- i. Airport Parking -To lessen ticket misrepresentation or errors, the license plate recognition units are utilized for catch these plates numbers with picture for these vehicles. This data might become utilized for ascertain these stopping times or give the proofing for stopping on the event for the lost tickets - an average issue on air terminal stopping while has generally lengthy (with costly) stopping spans.

## **1.1 PROBLEM DEFINITIONS**

The mainly purpose of the study is for propose an intelligent license plate detection system that uses image segmentation and enrichment techniques in a way that can be equivalent to modern systems in the world, and thus it can be applied to the Iraqi provinces in Iraq. This chapter presents the details of the adopted research methodology through discussing and describing the research processes and methods used to achieve the objectives of this study. To design and develop a License Plate Detection and character recognition system for vehicle Licenses Plates To develop a License Plate Detection and character recognition system for vehicle Licenses Plates utilize Convolution Neural Networks with Optical Character Recognition.

- i. Find a method with high accuracy for detecting the number plate from a given image.
- ii. Recognize each character from the detected number plate by using a suitable system.
- iii. To use this recognized vehicle number for identification and categorization of the vehicle.
- iv. To make this system efficient enough so that it would be useful in a variety of applications such as traffic Management, Automatic Toll and Vehicle Parking Payment Systems, Security and Crime detection.

A regular LPR framework contains a video picture obtaining subsystem, a central processor for picture handling and control, an equipment or programming-based character acknowledgment motor, and capacity or transmission subsystem for electronically recording plate contents what's more, information like date, time, and area. LPR systems normally consist of the following units:

- a. The camera(s) take pictures of the vehicle (front or rear).
- b. The lamp is a controllable light that can illuminate license plates, allowing it to work both day and night. Usually the brightness is infrared (IR), which cannot be detected by the driver.
- c. The point of interaction between the contour cameras with this computer allowed programming for control these images data.
- d. Computers - regularly the personal computer runs Windows or Linux. could running this license plate recognition application while control this framework, peruses these pictures, investigates with distinguishes these plates, addition to that, communicates utilize different applications with frameworks.
- e. Hardware - different info/yield sheets used to interact the outer world (for example, control sheets and systems administration sheets).
- f. Database - these occasions were record in the nearby data set and communicated on these networks. This information incorporates this acknowledgment analyzes with (alternatively) these vehicles and drivers-faces pictures record.

The license plate recognition framework could be thoughtfully considering such the contained double separates handling steps:

- i. Positioning plates.
- ii. Sequence Characters Recognize.

Tag School it the important milestone on vehicles tag recognize for suitable chassis. The containment stage of the LPR provides a dark scale page cut from the printed characters. A computational class that defines a set of successful LPL strategies for a given set of display conditions. Labeling Strategy (LPL), Morphology Based LPL Technique, Edge Index, Brain Organization, Emboss, Organize Layout in a comprehensive way. Aspect ratio, diversity, differentiation, edge thickness are some of the strengths of the labels used by the above strategies.

The big difference between the characters and the base of the label is something to consider when examining the edges.

## **1.2 CONTRIBUTION OF THESIS**

The main purpose of this project is to implement and evaluate the license plate recognition system using different learning techniques. The objectives as follows:

- a. To develop a License Plate Detection and character recognition system for vehicle Licenses Plates utilize Convolution Neural Networks with Optical Character Recognition.
- b. Find a method with high accuracy for detecting the number plate from a given image.
- c. Recognize each character from the detected number plate by using a suitable system.
- d. To use this recognized vehicle number for identification and categorization of the vehicle.
- e. To make this system efficient enough so that it would be useful in a variety of applications such as traffic Management, Automatic Toll and Vehicle Parking Payment Systems, Security and Crime detection.

## **1.3 THESIS ORGANIZATION**

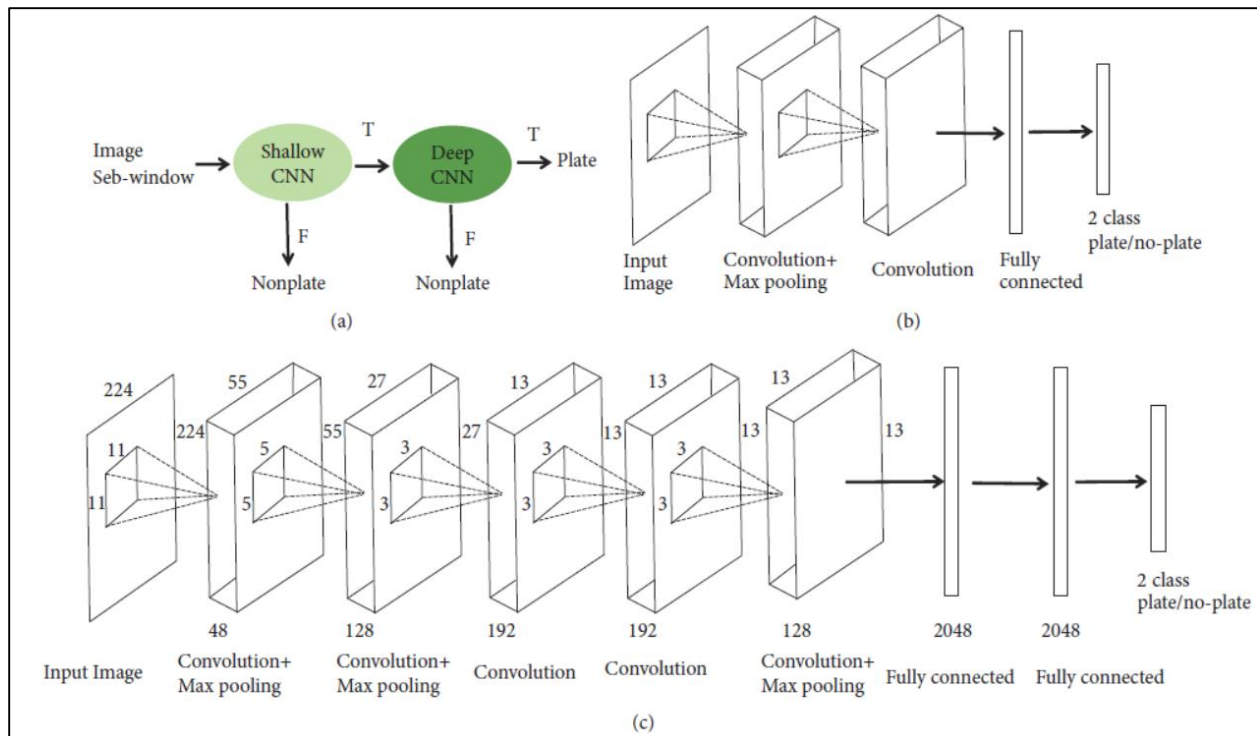
This section divided in five partitions, according to the section 2 exhibit this literature review is presented via previous work, part 3 for vehicle number plate recognition, our results are shown in section four that incorporate plan, reenact and test our examinations, in part five we shall give exhibit conclusions with idea to the futures advice.

## 2. LITERATURE REVIEW

On the current chapter, the literatures reviews to this recognition model are shown as follows respectively:

In [1] discussed the vehicles are entering educational institutions or other organizations without proper registration. A system should be established to determine whether this vehicle, which is used for plate detection and recognition, is registered with the institute. The Automatic License Plate Recognition (ANPR) system was used to solve this problem. This system can be used to collect parking fees, collect obstacles, find stolen cars, etc. using for. Useful for Some conditions may be affected by low light or weather; Disk size is also important. This document presents some techniques for implementing this system and shows the results of the automatic license plate recognition system.

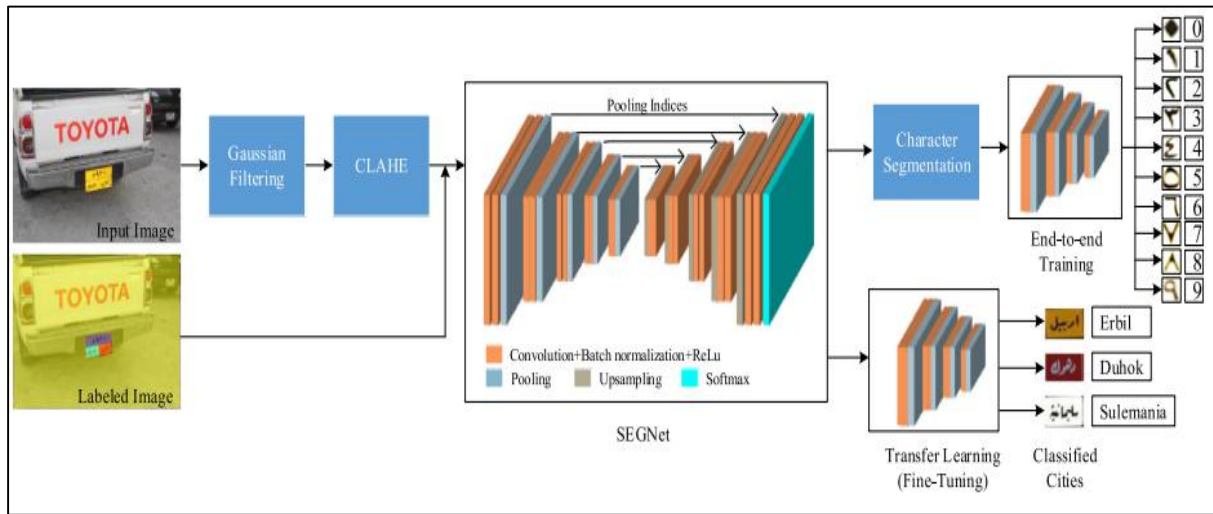
In [2] evaluated the Detection for License Plate by Shallow & Deep Learning CNNs in Complex Environments In this article author covers the many problems during license plate detection. For example, Large visual variations in a complex environment, blur images due to unfocused image, light issues like a high reflecting light or dim light daytime or nighttime and occlusion, etc. As a result, the background issue during license plate detection must be resolved. The advanced discriminative model is fulfilling the proper segmentation process of license plates from all types of backgrounds. That is why he is facing computational problems while detecting the plate. This technique proposes to model's 1st is Shallow CNN and 2nd is Deep learning [8] CNN [9]. To save computing time, Shallows CNN was utilized for delete significantly for these backgrounds area, and Deep CNN was used to identify the number plate in the remaining area. These two models work properly and make the efficient results of license plate detection and recognitions [10] in figure 3.



**Figure 2.1:** Proposed License Plate Detector.

In [3] proposed the cases many road accidents occur due to the violation of rules. People are not following the roles. They were needed to strictly obey the traffic rules. Developing countries are facing a lot of cases here violation of rules and its cause dangerous accidents. The reason for the violation of rules is the authorities do not enforce the public to follow the roles. That is why here need of which system which is enforce the public to follow the traffic rules. VPNR (Vehicle Plate Number Recognition) is a real-time embedded device that automatically recognizes vehicle plates. This system is useful to detect the vehicle through a number plate which violates the traffic rules. IR sensors used to detect the vehicle. Microprocessors use to detect the object within a minimum time interval. In this time interval camera captured the plate number image and sent to Raspberry Pi. The image capturing task was done with Raspberry Pi and image processing was done with a microprocessor. Numbers are recognized and viewed on the web page via an IP address The schematic representation for this suggested methodology it given on Figure one. As mentioned earlier, preprocessing, network segmentation, character segmentation, implicit learning and end-to-end block learning were studied to identify and define the proposed license. Each block is

presented in the following subsections. The input image is initially preprocessed and transmitted to the Seg Net architecture. Seg Net accepts input images and associated tagged images. The output of the Seg Net architecture benefits from character segmentation and training block transfers. Character segment output is transmitted to the end-to-end CNN architecture for license plate recognition. Cities are recognized according to a refined CNN.



**Figure 2.2:** The Proposed Method with the transfer learning tuning filtered via gaussian and CLAHE for indicates the pooling compared with Character Segmentation.

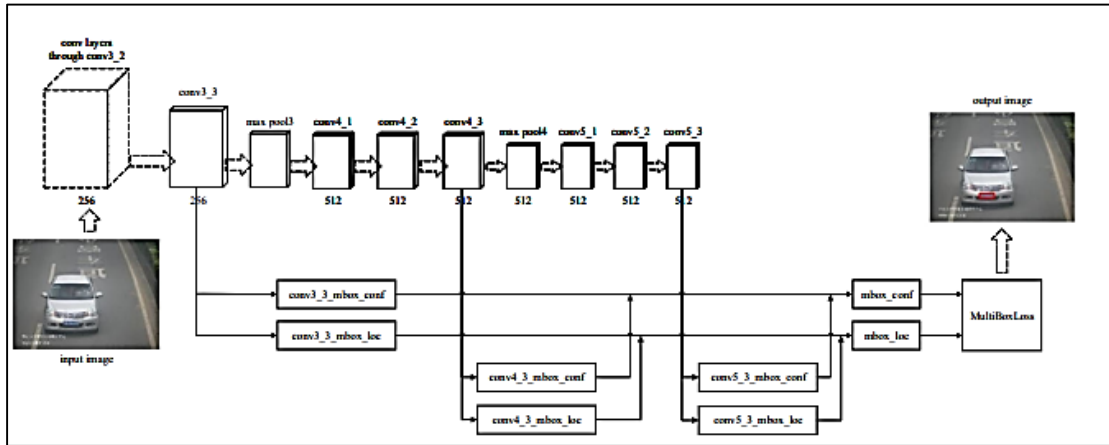
Modern objects detected algorithm depended in DL offer the promise forms for LPD. However, these are stilling double mainly difficulties. Firstly, exist method typical surround object and horizontally rectangle. However, horizontally rectangle won't be suitable, as the panels of the image are multi-directional, projected with rotate with perspectival distort. Secondly, these scales for the plate changes frequently, making it difficult to detect multiple scales. To solve the above-mentioned problems, we propose a new versatile invariant scale plaque detection (MOSILPD) method based on accumulation neural network. Our MOSILPD tightly surrounds omnidirectional plate and limited parallelogram, unless for plates scale. Be get bounded parallelogram, firstly parameterized these edges point for the plate via relatively locations. after, the designing map function via horizontally orient with provisioned regions. Next, by applying symmetric constraints to the function of loss with training this modelling via multiplicative losses. At final, the mapping made for the region hints for the triple edge's points for the neighboring array with subtract this

4th for form bounded parallel-o-grams. We first design the junction box according to the natural shape of the license plate to get a fixed ratio. Next, we look for difference layering for create regions suggestions via multi factors. additionally, the samples do this final layering with combination the auction feature extract start by the difference layering for realize the actual plate. The test result shown this suggested technique is superior to exist methods on detect sequences in difference directions with at many factors. LP detection it an important step in vehicle characterization. This is an LP site in a picture or videos streams. on those literatures, authors had utilized various computer vision and image processing techniques. However, other authors have chosen to use classification and machine learning approaches. Therefore, it could classify those techniques as: edges-depended, colors-depended, texture-depended, addition to that, characters-depended [1] techniques. An edge-based approaches it usually the way for detect the properties for the rectangles because LP takes those shapes via its aspect's ratios. Therefore, the model technique it often used for searching regard those rectangles [2] [3]. The motivation behind edge-based techniques is to track down picture districts with higher edge thickness than different areas of the picture to decide LP. Notwithstanding, the adjustment of brilliance and LP region is recognizable. Since [,5,6] utilized edge identification with morphological and numerical activities to find square shapes that could be PL. To precisely recognize LPs, Chen, and Luo [7] propose upgrading Prewitt's number juggling coefficients utilizing even and vertical projections. In [8], the creators present another line thickness separating technique to correspond locales with high edge thickness and concentrate scientific districts from paired edge pictures in every comment section. Among the highlights of edge-based strategies is higher identification speed. Nonetheless, we don't matter it to complex pictures because of its aversion to undesirable edges. Moreover, vinyl records will be hard to track down on the off chance that they are not open. The variety-based approach recognizes LPs by tracking down their variety in the picture. Shi et al. [9] and Zayed et al. [10] He proposed a variety model classifier. Moreover, the creators of [11] sectioned the variety pictures utilizing a competitor district change calculation. They then, at that point, appraised them regardless of LP. As a matter of fact, it is a blend of rectangular highlights, angle proportion, and meaning of these applicant districts. To address these differences in luminance, the authors proposed a unique fuzzy logic approach for LP color recognition. Indeed, LP inference using color information can detect asymmetrical and distorted LPs. However, the approach is delicate to many

light boundaries and experiences bogus up-sides, particularly when different pieces of the test picture have a similar LP tone. Surface based techniques endeavored to distinguish districts of the ideal pixel thickness dispersion in the LP. The creators utilized the [12] Support Vector Machine (SVM) to dissect the variety portrayal of the LP tissue. They then, at that point, utilize the CAM Shift (Continuous Adaptive Average Shift) calculation on the outcomes to decide the LP districts. In [13], the creators utilized wavelet change to recognize explicit elements and subtleties in vertical or even pictures. [one] In [15], the creators consolidated Haarlike highlights with versatile streamlining to acquire successive LP rejection classifiers. Moreover, these Haar-like highlights can be utilized to recognize objects, subsequently making the classifier steady for size, variety, and LP luminance. Utilized by Ad support [16] series, which has higher precision for LP location. As indicated by Giannakos et al. [17] fostered a concentric sliding window calculation to choose LPs in view of nearby inconsistency of plate surface in the picture. Trigger setting checking was utilized to accelerate revelation. LP can be recognized by tissue-based techniques regardless of whether the limit is broken. Be that as it may, these techniques are computationally mind boggling, particularly when there are many edges. Character-based approaches will perceive the LP as a series of characters while identifying by checking for the presence of characters on the screen. What's more, Li et al. [18] applied the Maximum Stable Pole Region (MSER) in the initial step to extricate competitor characters from the picture. The creators then, at that point, made a contingent randomization field (CRF) to address the connection between LP characters. Last LPs still up in the air by certainty spread surmising on the CRF. In [19] the creators named a parallel article with the very same angle proportion as a solitary person and more than 30 pixels. Truth be told, a Hough change was applied to recognize comparable lines for the bottoms of these associated objects. Assuming that two lines have similar numbers and characters yet are lined up inside a specific reach, creators will regard the distance between them as a LP. Hontani et al. [20] applied scale-spatial examination to separate characters and these classes were utilized to encode semantic data. Then, change 3 was utilized to identify tags by assessing certainty scores and box counterbalances.

furthermore, we add an assistant develop called change 5\_3. We then incorporate the data from these three layers utilizing a non-greatest concealment (NMS) calculation to get the last up-and-comer plate and its area. Conv3\_3 has a lot better spatial subtleties and is utilized for little

arrangement recognition. Though the 5\_3 contention has bigger responsive fields which are valuable for recognizing bigger clusters. it is easy for us to detect arrays of different sizes, especially small arrays. Next, we add support structures such as batch normalization to the training network to improve PA and rationalize the model. We get 1% improvement by adding batch normalization in our tests. These speeds up convergence.



**Figure 2.3:** The License Plate Detection Pipeline.

Since default boxes are the basis of object detection, several methods have been proposed to create area suggestions. Customary strategies incorporate particular looking and have been proposed by SPPnet, He et al. [one]. RPN utilized in RCNN is a lot of increasingly fast than past techniques. Our framework involves the arrangement as a RPN, and we partner a bunch of default jumping boxes with each element map cell in each various leveled highlight class. Every cell in the various leveled include class is related with 6 cells as a matter of course (2 scales and 3 viewpoint proportions). Dissimilar to Faster RCNN we use default boxes from various element classes comparing to various tag recognition scales Misfortune work We make two kin classes for each progressive class. The main kin classes produce each bouncing box relapse inclination, while the subsequent kin classes create the default per-box certainty. Lost position:

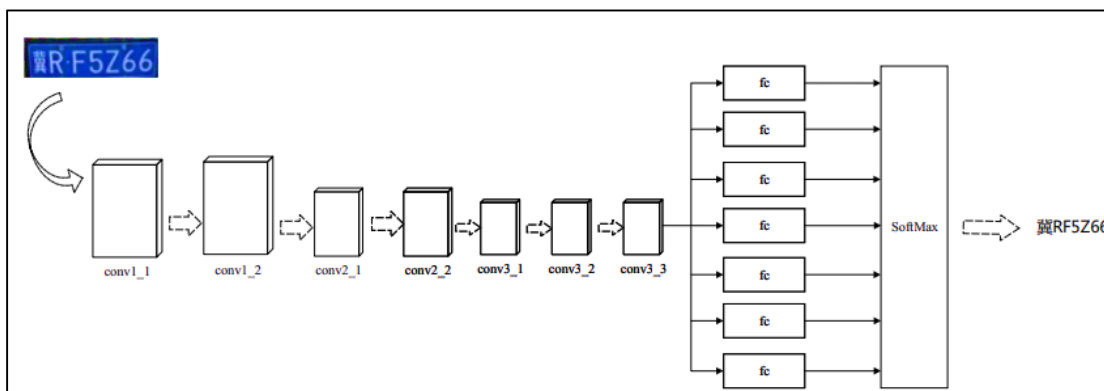
$$Loss_i = \frac{1}{N_{reg}} \sum_i L_{reg}(t_i; t_i^*) \quad (2.1)$$

where  $N_{reg}$  is the quantity of default boxes chosen,  $L_{reg}$  is the relapse loss of the forecast box determined by SmoothL1,  $t_i$  is the assessed deviation of the bouncing box, and  $t_i^*$  is the directions

of the basic information box. In the default box, we demonstrate a positive occasion when the crossing point (IoU) over solidarity agrees with a ground truth over an edge (eg 0.7). We utilize these models and apply delicate L1 misfortune to the jumping box relapse as Fast RCNN does. Beat:

$$Loss_c = \frac{1}{N_{cls}} \sum_i L_{cls}(P_i; P_i^*) \quad (2.2)$$

where  $N_{cls}$  describe the training number for samples involve negative and positive.



**Figure 2.4:** The Character Recognize Network Pipeline.

In [21] evaluated the Detection for License Plate by Shallow & Deep Learning CNNs in Complex Environments In this article author covers the many problems during license plate detection. For example, Large visual variations in a complex environment, blur images due to unfocused image, light issues like a high reflecting light or dim light daytime or nighttime and occlusion, etc. As a result, the background issue during license plate detection must be resolved. The advanced discriminative model is fulfilling the proper segmentation process of license plates from all types of backgrounds. That is why he is facing computational problems while detecting the plate. This technique proposes to model's 1st is Shallow CNN and 2nd is Deep learning CNN. To save computing time, Shallows CNN was utilized for delete significantly for these backgrounds area, and Deep CNN was used to identify the number plate in the remaining area.

In [22] evaluated the vehicles are entering educational institutions or other organizations without proper registration. A system should be established to determine whether this vehicle, which is

used for plate detection and recognition, is registered with the institute. The Automatic License Plate Recognition (ANPR) system was used to solve this problem. This system can be used to collect parking fees, collect obstacles, find stolen cars, etc. using for. Useful for Some conditions may be affected by low light or weather; disk size is also important. This document presents some techniques for implementing this system and shows the results of the automatic license plate recognition system.

In [23] illustrated the cases many road accidents occur due to the violation of rules. People are not following the roles. They were needed to strictly obey the traffic rules. Developing countries are facing a lot of cases here violation of rules and its cause dangerous accidents. The reason for the violation of rules is the authorities do not enforce the public to follow the roles. That is why here need of which system which is enforce the public to follow the traffic rules. VPNR (Vehicle Plate Number Recognition) is a real-time embedded device that automatically recognizes vehicle plates. This system is useful to detect the vehicle through a number plate which violates the traffic rules. IR sensors used to detect the vehicle. Microprocessors use to detect the object within a minimum time interval. In this time interval camera captured the plate number image and sent to Raspberry Pi. The image capturing task was done with Raspberry Pi and image processing was done with a microprocessor. Numbers are recognized and viewed on the web page via an IP address The schematic representation for this suggested methodology it given on Figure one. As mentioned earlier, preprocessing, network segmentation, character segmentation, implicit learning and end-to-end block learning were studied to identify and define the proposed license. Each block is presented in the following subsections. The input image is initially preprocessed and transmitted to the Seg Net architecture. Seg Net accepts input images and associated tagged images. The output of the Seg Net architecture benefits from character segmentation and training block transfers. Character segment output is transmitted to the end-to-end CNN architecture for license plate recognition. Cities are recognized according to a refined CNN.

Modern objects detected algorithm depended in DL offer the promise forms for LPD. However, these are stilling double mainly difficulties. Firstly, exist method typical surround object and horizontally rectangle. However, horizontally rectangle won't be suitable, as the panels of the image are multi-directional, projected with rotate with perspectival distort. Secondly, these scales

for the plate changes frequently, making it difficult to detect multiple scales. To solve the above-mentioned problems, we propose a new versatile invariant scale plaque detection (MOSILPD) method based on accumulation neural network. Our MOSILPD tightly surrounds omnidirectional plate and limited parallelogram, unless for plates scale. Be get bounded parallelogram, firstly parameterized these edges point for the plate via relatively locations. after, the designing map function via horizontally orient with provisioned regions. Next, by applying symmetric constraints to the function of loss with training this modelling via multiplicative losses. At final, the mapping made for the region hints for the triple edge's points for the neighboring array with subtract this 4th for form bounded parallel-o-grams. We first design the junction box according to the natural shape of the license plate to get a fixed ratio. Next, we look for difference layering for create regions suggestions via multi factors. additionally, the samples do this final layering with combination the auction feature extract start by the difference layering for realize the actual plate. The test result shown this suggested technique is superior to exist methods on detect sequences in difference directions with at many factors. LP detection it an important step in vehicle characterization. This is an LP site in a picture or videos streams. on those literatures, authors had utilized various computer vision and image processing techniques. However, other authors have chosen to use classification and machine learning approaches. Therefore, it could classify those techniques as: edges-depended, colors-depended, texture-depended, addition to that, characters-depended [24] techniques. An edge-based approaches it usually the way for detect the properties for the rectangles because LP takes those shapes via its aspect's ratios. Therefore, the model technique it often used for searching regard those rectangles [25] [26]. The motivation behind edge-based techniques is to track down picture districts with higher edge thickness than different areas of the picture to decide LP. Notwithstanding, the adjustment of brilliance and LP region is recognizable. Since [27] utilized edge identification with morphological and numerical activities to find square shapes that could be PL. To precisely recognize LPs, Chen, and Luo [28] propose upgrading Prewitt's number juggling coefficients utilizing even and vertical projections. In [29], the creators present another line thickness separating technique to correspond locales with high edge thickness and concentrate scientific districts from paired edge pictures in every comment section. Among the highlights of edge-based strategies is higher identification speed. Nonetheless, we don't matter it to complex pictures because of its aversion to undesirable edges. Moreover,

vinyl records will be hard to track down on the off chance that they are not open. The variety-based approach recognizes LPs by tracking down their variety in the picture. Shi et al. [30] and Zayed et al. [31] He proposed a variety model classifier. Moreover, the creators of [32] sectioned the variety pictures utilizing a competitor district change calculation. They then, at that point, appraised them regardless of LP. As a matter of fact, it is a blend of rectangular highlights, angle proportion, and meaning of these applicant districts. To address these differences in luminance, the authors proposed a unique fuzzy logic approach for LP color recognition. Indeed, LP inference using color information can detect asymmetrical and distorted LPs. However, the approach is delicate to many light boundaries and experiences bogus up-sides, particularly when different pieces of the test picture have a similar LP tone. Surface based techniques endeavored to distinguish districts of the ideal pixel thickness dispersion in the LP. The creators utilized the [33] Support Vector Machine (SVM) to dissect the variety portrayal of the LP tissue. They then, at that point, utilize the CAM Shift (Continuous Adaptive Average Shift) calculation on the outcomes to decide the LP districts. In [34], the creators utilized wavelet change to recognize explicit elements and subtleties in vertical or even pictures. [one] In [35], the creators consolidated Haar like highlights with versatile streamlining to acquire successive LP rejection classifiers. Moreover, these Haar-like highlights can be utilized to recognize objects, subsequently making the classifier steady for size, variety, and LP luminance. Utilized by Ad support [36] series, which has higher precision for LP location. As indicated by Giannakos et al. [37] fostered a concentric sliding window calculation to choose LPs in view of nearby inconsistency of plate surface in the picture. Trigger setting checking was utilized to accelerate revelation. LP can be recognized by tissue-based techniques regardless of whether the limit is broken. Be that as it may, these techniques are computationally mind boggling, particularly when there are many edges. Character-based approaches will perceive the LP as a series of characters while identifying by checking for the presence of characters on the screen. What's more, Li et al. [38] applied the Maximum Stable Pole Region (MSER) in the initial step to extricate competitor characters from the picture. The creators then, at that point, made a contingent randomization field (CRF) to address the connection between LP characters. Last LPs still up in the air by certainty spread surmising on the CRF. In [39] the creators named a parallel article with the very same angle proportion as a solitary person and more than 30 pixels. Truth be told, a Hough change was applied to recognize comparable lines for the

bottoms of these associated objects. If two lines have similar numbers and characters yet are lined up inside a specific reach, creators will regard the distance between them as a LP. Hontani et al. [40] applied scale-spatial examination to separate characters and these classes were utilized to encode semantic data. Then, change 3 was utilized to identify tags by assessing certainty scores and box counterbalances.



### 3. METHODOLOGY

#### 3.1 MOTIVATION

The mainly purpose of the study is for propose an intelligent license plate detection system that uses image segmentation and enrichment techniques in a way that can be equivalent to modern systems in the world, and thus it can be applied to the Iraqi provinces in Iraq. This chapter presents the details of the adopted research methodology through discussing and describing the research processes and methods used to achieve the objectives of this study.

#### 3.2 DESIGN RESEARCH METHODOLOGY

Research method reflect the strategies and procedures utilized by author at the different phases of research. The method of research utilized in this study is the general Research Design Methodology created by Vaishnavi and Kuechler (2019). It comprises of five stages specifically: Awareness of an issue, Suggestion, Development, Testing, Evaluation and Conclusion as portrayed in Figure 3.1. Each stage is explained in the accompanying subsections exhaustively.

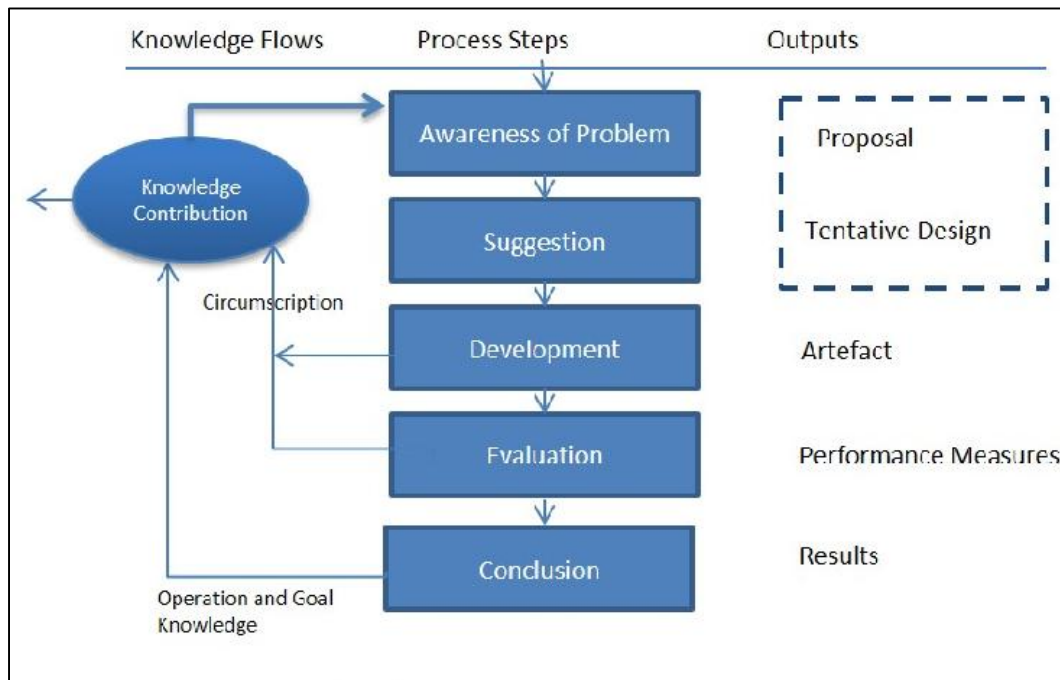


Figure 3.1: Designing of SRP Model.

### **3.3 DESIGN MODEL**

Nowadays, the number of cars in Iraq is increasing rapidly, and modern people want to go to work, shop, go to class, etc. It becomes an important base to get there. Conventional traffic checking techniques at times don't give the ideal arrangement [1]. To defeat this issue, programmed tag recognition innovation ought to be created. VLP auto-location frameworks offer more prominent proficiency and specialized benefits over customary traffic observing frameworks [1]. Likewise, extra traffic data can be acquired from pictures, for example, vehicle order, path changes, and a solitary camera can screen various paths and read vehicle data at the same time [2, 3]. A few VLP discovery techniques have been presented up to this point, however enhancement is expected to further develop speed and exactness. This is due to the accuracy of some license plate detection algorithms.

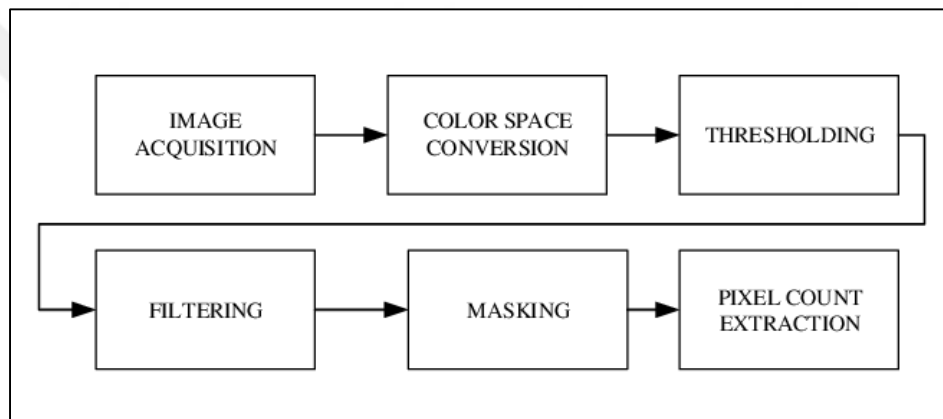
### **3.4 AWARENESS OF PROBLEM**

the number of cars in Iraq is increasing rapidly, and modern people want to go to work, shop, go to class, etc. It becomes an important base to get there. Conventional traffic checking techniques occasionally don't give the ideal arrangement [1]. To defeat this issue, programmed tag recognition innovation ought to be created. VLP auto-discovery frameworks offer more prominent effectiveness and specialized benefits over customary traffic checking frameworks [1]. Furthermore, extra traffic data can be acquired from pictures, for example, vehicle grouping, path changes, and a solitary camera can screen different paths and read vehicle data all the while [3]. A few VLP recognition techniques have been presented up until this point, yet streamlining is expected to further develop speed and precision. This is because of the precision of some tag location calculations.

### **3.5 SUGGESTION FOR THE PROBLEM**

This study proposes to design an intelligent license plate detection system using image enhancement and segmentation techniques as a warning way to solve the problem described in Chapter 1 and Chapter 3.2. The system can warn the user that the license plate has been successfully detected. It helps traffic authority decide to detect license plate, it is basically

recognition from license plate. However, the acknowledgment interaction generally relies upon picture handling strategies like picture division. Accordingly, the strategy of this study is separated into three stages. Preprocessing, division, and matching are the means. The preprocessing step requires handling the crude picture caught with an advanced camera until a specific piece of the picture is acquired. The subsequent stage is division, which is utilized to recognize letters and numbers in tag pictures. At long last, a matching cycle is utilized to coordinate the extricated picture character with genuine characters. The fundamental picture handling procedure is outlined in Figure 3.2 with a block diagram.



**Figure 3.2:** Fundamental Concept of Image Processing Technique.

In this work, fifty pictures caught with an advanced camera from various traffic organizations in Iraq that gathered and investigated for quality, like clear picture, insignificant aggravation, and great picture view. The pictures were then isolated into two gatherings: pictures with a dark foundation for the vehicle plate and pictures with a white foundation for the vehicle plate, as displayed in Fig. 3.3 and Fig. 3.4 Assuming that the picture is acknowledged, it will be dissected involving picture handling strategies in Java. Another picture will be taken on the off chance that the past one is dismissed. Prior to continuing on toward the following stages, the cycle will be rehashed until a decent picture is acquired. Picture handling tool compartment will be utilized to deal with the picture.



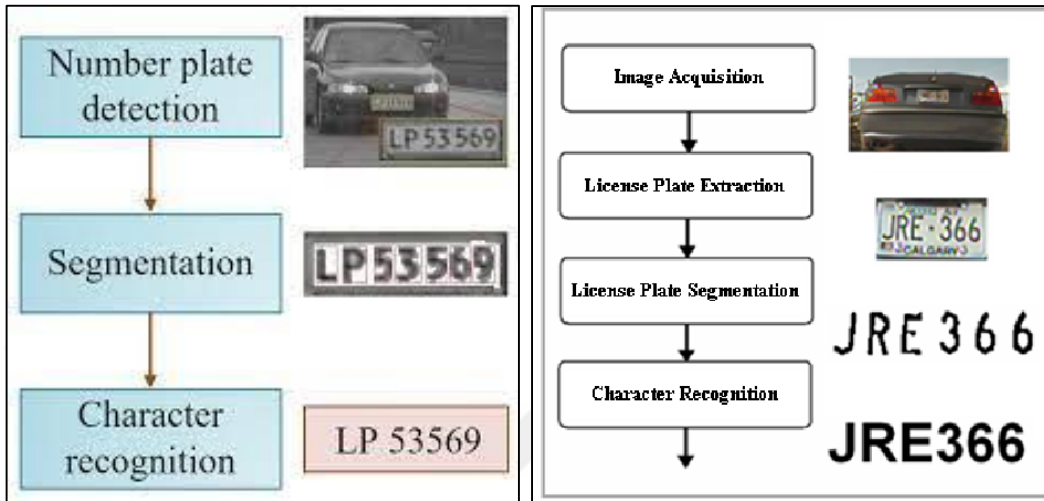
**Figure 3.3:** The Vehicle Plate Number with Black Background.



**Figure 3.4:** The Vehicle Plate Number with White Background.

Develops a system for programming and image segmentation in Java. It works shorter and faster than ever before for vehicle license plate detection and image resolution. Nor do we need high-spec computers to increase the speed of number detection. For this reason, we developed the work in Java. It does not need a high specification computer that works only to take a picture of the car. When you select the plate to discover the number, the car plate is captured only and this is easy for us if the weather is not suitable, then it turns the image into gray, then cuts the photo of the car plate and reveals the car numbers In addition to the ease of use of the system for the user in terms

of designing the program interface and adding tools For ease of work in the system. This is useful in shortening the time.



**Figure 3.5:** The Four Stages of An ALPR System.

The working on testing the system in terms of ease of use, speed of detection, and accuracy of sound detection in all circumstances, unlike previous work in previous studies in terms of program design and ease of work for the user. We distribute the system to conduct a test. This is evaluated by experts and evaluated in terms of speed, detecting the car plate, identifying the plates, and revealing the number in less time than before, where the user can use the system in any computer that does not need high specifications that can work on any computer Image preprocessing is an essential part of image analysis. With no need for legitimate pre-handling, recognizable proof will be ineffectual or may yield mistaken results. The primary justification behind preprocessing is to work on the quality and comprehensibility of the shortened LP characters to be communicated for division and acknowledgment. The various techniques we apply are RGB picture to grayscale transformation, sound decrease and picture encoding.

- i. RGB for grayscale conversions: Grayscale conversions it utilized to convert color images to black and white images. Color images do not help us detect prominent edges and other features. Therefore, it is very important to convert an image to Grayscale format. The main reason to use this transformation is for decrease this colors number. After converting these images for grayscale, the next step for blur these images. Images noise is picture debasement made by camera glitch or unfortunate perceivability due changing atmospheric conditions. Commotion

is likewise arbitrary varieties in pixel thickness levels. Commotion can be of various kinds, like salt clamor, Gaussian commotion, and pepper clamor. This proposed technique is to wipe out the commotion. It gives a sound decrease component while safeguarding the edges. Fundamentally in light of the fact that we give improved results.

- ii. Binarize is characterized as the method involved with changing over a picture into a picture that has just two-pixel esteems, the white pixel and the dark pixel. Running the parallel encoding process prior to distinguishing the tag and eliminating it from the picture will make the plate location work simpler as the edges will be more splendid in the paired picture. Binarization is finished by picking a limit esteem. In the wake of choosing the worth, we examine the pixel values in the picture. Assuming it's higher than the edge, set that pixel to likewise be all white or dark.

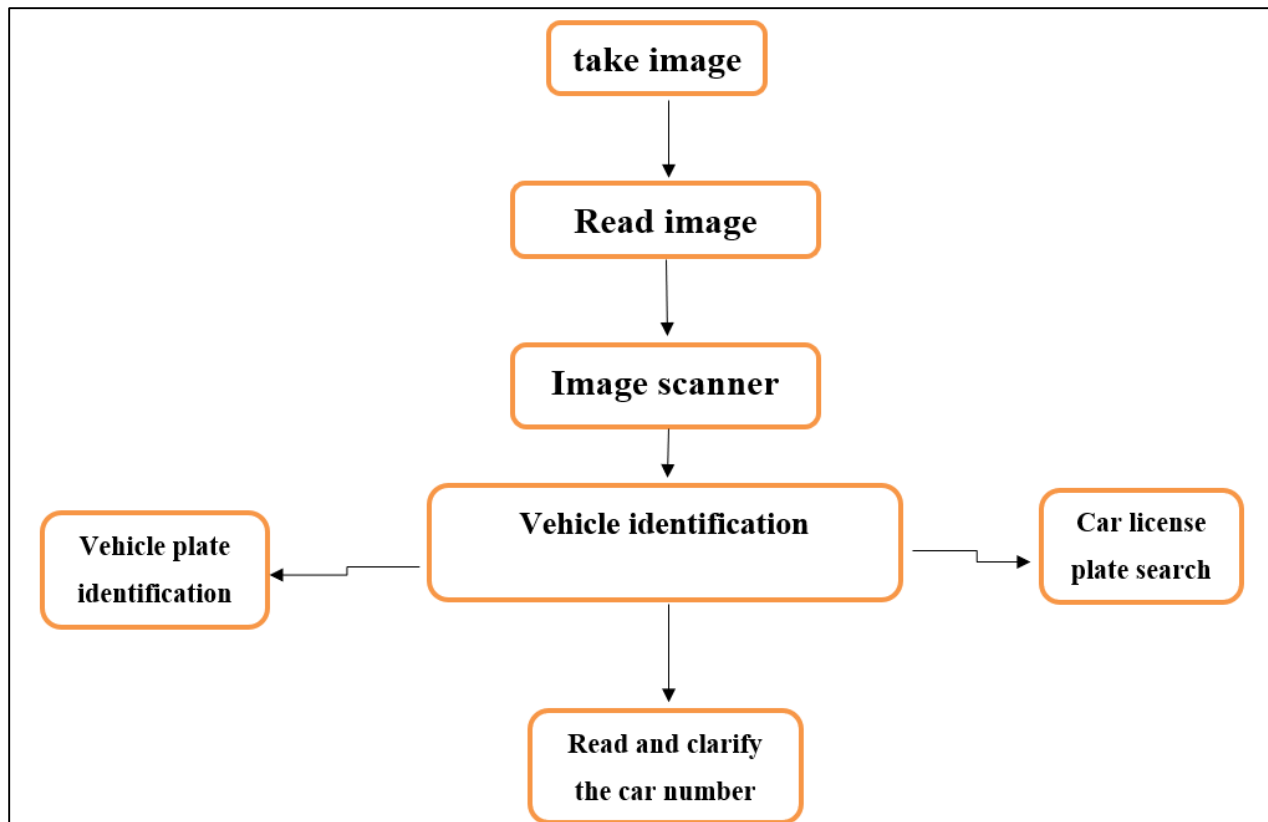
They led broad investigations to assess the suggestions. In this segment, we first present our dataset for preparing and testing. Then, we give execution subtleties and assessment measures. At last, we look at and break down the exhibition among us and our center calculations. Test results show that it firmly encompasses omnidirectional plates with restricted parallelograms and proficiently identifies plates at different factors. It is also very robust in harsh conditions and achieves comparable detection rates. We are working on evaluating the system by experts who have valuable information in this field. Here it shows us if there are defects or problems in the system and assesses the convenience of the program and the improvement of the framework Image handling procedures depend on basic highlights, for example, variety maps, edges, variety histograms, and paired encoding, so they are delicate to evolving conditions. As expressed in the part. In 3.1 we tried this procedure with various choices. Versatile cloning works best in various vehicle variety forces and conditions. Mass location applied to variety properties and edge properties works something very similar on quantitative numbers as we didn't consider ROI of course previously. The most recent calculation, tentatively demonstrated to be ideal for LP recognition, utilizes Otsu double coding with foggy grayscale pictures. Precision is subject to the surface of the test picture, for example, residue and vehicle variety designs as smircesh and bogus up-sides increment. Another variable that immensely affects the last precision is the example matching method, which in this study was a straight SVM utilizing a variety histogram. SVM is

utilized to eliminate misleading up-sides from masses that are at last separated during starting location. Cautious determination of elements and preparing models decidedly affects last discovery. Utilizing a calculation, It required around 0.35 seconds to distinguish LPs in 80 pictures. Test SVM assortment additionally relies upon the quality and attributes of positive examples. It utilizes each occurrence to make a different SVM so handling time increments as every dynamic occasion is added. Nonetheless, tests show that this impact isn't huge if under 180 positive examples tried in this review. Furthermore, since each example is analyzed independently for coordinating, it tends to be accurately expected that parallelism might force a maximum cutoff on handling speed. One more test done in this review is to prepare the SVM test with a LP from a particular locale (for example European LP) and test it with another well-performing locale (for example KoreanLP). a larger number of highlights of a LP than its substance. Example SVMs assortment performs very well with precise identifications, however, isn't appropriate for constant frameworks because of slow calculation time for example 3 s/picture. Exactness is expanded with proceeding with training as tests can be added and eliminated on the web. FasterRCNN is the most ideal for ongoing frameworks. As found in the tried recordings and the outcomes, the field idea technique assumes a significant part in the right assurance. With ZF CNN organization, FasterRCNN gives lower execution than video dataset because RPN involves rectangular districts for offering. Notwithstanding, the ZF CNN and FasterRCNN were quickest at 0.07 seconds/outline, while the VGG16 CNN was adequate at 0.16 seconds/outline. Looking is computationally costly and hence unsatisfactory for continuous frameworks. Be that as it may, the exactness of specific hunt was somewhat higher than the precision of RPN in the tests acted in this review. Considering the continuous presentation on the picture dataset, the shallower cross section of ZF outflanks the somewhat profound lattice VGG16s on some datasets. Video space proposals can be additionally diminished and upgraded by applying disengaged observation procedures.

## 4. SIMULATION RESULTS

The mainly purpose of the study is for propose an intelligent license plate detection system that uses image segmentation and enrichment techniques in a way that can be equivalent to modern systems in the world, and thus it can be applied to the Iraqi provinces in Iraq. This chapter presents the details of the adopted research methodology through discussing and describing the research processes and methods used to achieve the objectives of this study. To design and develop a License Plate Detection and character recognition system for vehicle Licenses Plates To develop a License Plate Detection and character recognition system for vehicle Licenses Plates utilize Convolution Neural Networks with Optical Character Recognition.

- i. Find a method with high accuracy for detecting the number plate from a given image.
- ii. Recognize each character from the detected number plate by using a suitable system.
- iii. To use this recognized vehicle number for identification and categorization of the vehicle.
- iv. To make this system efficient enough so that it would be useful in a variety of applications such as traffic Management, Automatic Toll and Vehicle Parking Payment Systems, Security and Crime detection. The proposed system in this thesis has many advantages, the most important: First, it does not require high-spec hardware to run smoothly. Second, the ability of this system to adapt to images of poor quality, as it has the capabilities to improve and process them. Third, it can work in bad weather and environments. Fourth, the most prominent point in this system is the high speed of treatment and giving results in a record time of approximately 200 milliseconds. The pages of this chapter of the thesis have been devoted to presenting the proposed system's details, mechanism of action, and requirements. The designed system goes through several stages. Initially, the photo is taken if a vehicle exceeding the specified speed passes. The next step is scanning the captured image and measuring the length and width. Then the car is accurately identified. And in the end, the important part of the car is determined, which is the car plate with all its details.



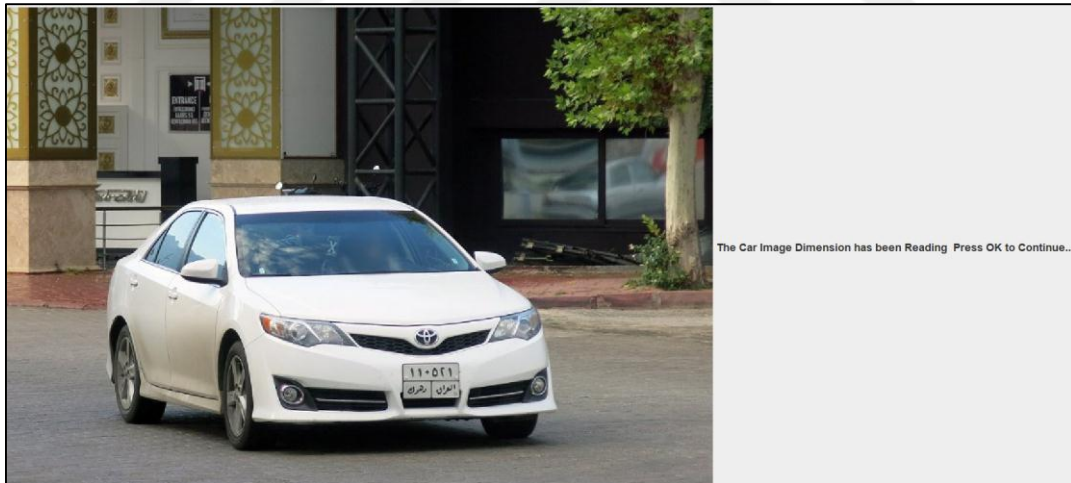
**Figure 4.1:** The Conceptual Design for The Proposed System.

In this system, it detects the car in the event of speeding or theft. In this case, the photo of the car is taken, and the license plate is detected in all circumstances. It starts from here reading the image. It reads the image by pixels, height and race, then finds the car and determines the car. In this section, I will explain the system in detail about how the system works in terms of operation, detection speed, image reading, image cutting and all these details. In the first stage, the car is searched in the event of a speed violation, a traffic violation or theft of a car. Here the role of searching for the car upon detection works to find out the information as soon as possible as shown in the figures below which describe the car search process by applying a message.



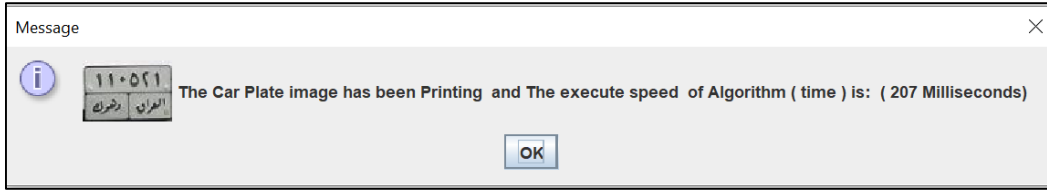
**Figure 4.2:** The Car Search Process with a Discovered Camera for License Plate System.

At this stage, we do not need processors that give us a high speed to shorten the time. On the contrary, this system works with the least capabilities and specifications and gives you the best result than its predecessor in terms of speed and detection. After the photo is taken, work is done to read the photo. In the process of searching for the board, it reads all the pixels in the image. All rows are read, then the length is determined by width and vehicle selection. This whole process takes milliseconds.



**Figure 4.3:** The Vehicle Selection Method for License Plate System.

At this part of the work, you need to accurately detect the car plate after the values in the process of scanning the car and searching for the plate. It can work in bad climatic conditions and environments. The most prominent point in this system is the high speed of treatment and giving results in a record time of approximately 200 milliseconds. In terms of detection, the time varies according to one image to another.



**Figure 4.4:** The Car Plate Detected via License Plate System.

And in this final stage, I conclude my system work and clarify the good work, unlike previous work, revealing the car plate.



**Figure 4.5:** The Final Stage of The Work.

According to the evaluation, Design of a vehicle plate tracking system and detection through the system It can be a flexible and efficient model in terms of speed and improve image resolution table 4 lists the system evaluation components. Agree the highest average score of 4.5, which shows the difference between the previous studies because the users of the system have a positive effect when using and this stops the difference from the previous studies and the improvement in the system.

**Table 4.1:** Blended learning.

NO	Evaluation Item	X	$\delta$
1	It helps me to use this system to detect the dashboard of the car, it has improved than before	4.3	0.74
2	System development is very important to shorten time	4.5	0.76
3	Self-monitoring can be used to detect violators	4.4	0.73
4	I felt a sense of satisfaction with the system of revealing the license plate.	4.3	0.70
5	Blended Learning Average	4.4	0.70

This is consistent with the results. (2021) who indicated that The result can improve the detection of the car dashboard, they can take advantage of order, increase participation and motivation. Consider to the flexibility, one of the successful factors in developing the system is gaining time and this is the main factor in the system It aims to create an easy-to-use system that works smoothly and with good flexibility Users have reported great satisfaction with the ease of operation of the presented system In addition to the ability to access and reveal the car plate in a faster time, and this is what we aspire to develop.

**Table 4.2:** Flexibility.

NO	Evaluation Item	X	$\delta$
1	I can take several photos at once.	4.4	0.63
2	I can access monitor the car for which a picture was taken.	4.4	0.67
3	I was able to take pictures in bad weather without much difficulty	4.3	0.85
4	The system provides a wide range of options to facilitate the system.	4.6	0.70
5	Flexibility Average	4.4	0.71

Illustration to the high-quality content, one of the most important factors is image quality, to show that this system is developed with an image that is involved in checking image quality and accuracy, a good and fast system, a clear width scheme, and a correct length. It aims to capture a clear and quick picture and shows the assessment which is listed in the table. quality measurement.

**Table 4.3:** High quality content.

NO	Evaluation Item	X	$\delta$
1	Display sleeper in clear form.	4.4	0.74
2	The system's ease of detection helps the car's plate to be organized.	4.5	0.71
3	Comments on my annotations help me figure out what's wrong with it.	4.3	0.86
4	Reviewing the system bookmarked at each node in a video helps me improve video resolution.	4.6	0.93
5	High Quality Content Average	4.4	0.81

With the modelling of the designed system, can make the system efficient and more Attractive and stimulating. Table 12 shows evaluation Effective design system used.

**Table 4.4:** Designing.

NO	Evaluation Item	X	$\delta$
1	The goals of the system are clearly defined in each trial. .	4.2	0.84
2	The license plate detection is clearly identified.	4.5	0.80
3	I always know my place in the beta system.	4.3	0.64
4	The system responds directly when in use.	4.6	0.93
5	Designing Average	4.4	0.57

self-learning system is one of the characteristics of massive online courses. Indicates intelligent saving system An experience for a large number of participants all over the world regardless of their location, Fee for accessing a high-quality system. Most of the huge systems on the Internet are located in, for example, do not allow users reproduce, retransmit, distribute, or publish the

system any material from its platform. Below is a description of the respondent's satisfaction with the level of the system Provided users only register.

**Table 4.5:** Self-learning system.

NO	Evaluation Item	X	$\bar{\sigma}$
1	I am allowed to create my own system mind map.	4.2	0.84
2	I decide how much I want the system to detect the plate in a given time period.	4.5	0.80
3	I have the possibility to ask the other system user what I don't understand.	4.3	0.64
4	I can organize my own detection panels activities.	4.6	0.93
5	self-learning system Average	4.4	0.57

The average was 4 indicating that the majority agreed with the system be subjective in their detection process. In particular, the Participants reported that the application of the system is a mind map display method and The feature of videos and screenshots helped them learn independently from previous systems. Results It further confirms that the system environment encourages users to work in their places at their own pace to achieve their own learning goals and to keep them in control. this is It shows that users have had some difficulties in tracking and monitoring the system activities and those of their peers. Further improvement should be done to address this important issue. This could be in the form of a learning analytics tool that enables to collect, Visualize and analyze data from learning activities (eg comments, likes, recent Added nodes) to support observation, awareness, and self-reflection.

## 5. CONCLUSION

In this part, many challenges had been introduced and enhanced to solve the main issue regard vehicles registration system additionally, many problems had been solved according to the recognition system with the proposed convolutional neural network for detection and recognition process with the transfer learning acquired by input image based on the pooling layers, in this proposed work, data analyzes had been inserted and improved via application that executed by java programming and based on built an application which is responsible for detect, recognize and prevent the cars from stealing operation by the vehicle number plates recognition and applied for many Iraqi cities like, Erbil, Sulemani, Duhok.

In the future advice recommended to use:

- i. insert alarm connected with the camera for detection.
- ii. utilize high resolution camera made the process more accurate.
- iii. increase the speed capture for camera (frames) to increment the frame process detection.

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## APPENDIX A

### [VEHICLE NUMBERING PLATES ON JAVA PROGRAMMING]

```
import java.awt.Dimension;
import java.awt.Rectangle;
import java.awt.image.BufferedImage;
import java.awt.image.RasterFormatException;
import java.io.File;
import java.io.IOException;

import javax.imageio.ImageIO;

public class QAA {

    static Rectangle clip;

    public static void main(String args[]) throws Exception {
        String inputFileLocation = "img/1.jpg";
        String outputFileLocation = "img/Plate.jpg";

        System.out.println("Reading Original File : " + inputFileLocation);

        BufferedImage originalImage = readImage(inputFileLocation);

        /**
```

```

* Image Cropping Parameters pixelStartY
*/

BufferedImage processedImage = cropMyImage(originalImage, pixelWidth,
pixelHeight, pixelStartX, pixelStartY);

System.out.println("Writing the Recognition Plate image to: "
+ outputFileLocation);
writeImage(processedImage, outputFileLocation, "jpg");
System.out.println("...Done");
}

public static BufferedImage cropMyImage(BufferedImage img, int pixelWidth,
int pixelHeight, int pixelStartX, int pixelStartY) throws Exception {
BufferedImage RecognitionPlate = null;
Dimension size = new Dimension(pixelWidth, pixelHeight);

createClip(img, size, pixelStartX, pixelStartY);

try {
int w = clip.width;
int h = clip.height;

System.out.println("Recognition Plate Width " + w);
System.out.println("Recognition Plate Height " + h);
System.out.println("Recognition Plate Location " + "(" + clip.x + "," + clip.y

```

```
RecognitionPlate = img.getSubimage(clip.x, clip.y, w, h);
```

```
System.out.println("Image Recognition. New Image Dimension: "  
+ RecognitionPlate.getWidth() + "w X " + RecognitionPlate.getHeight() + "h");  
} catch (RasterFormatException rfe) {  
System.out.println("Raster format error: " + rfe.getMessage());
```

```
RecognitionPlate = img.getSubimage(clip.x, clip.y, w, h);
```

```
System.out.println("Image Recognition. New Image Dimension: "  
+ RecognitionPlate.getWidth() + "w X " + RecognitionPlate.getHeight() + "h");  
} catch (RasterFormatException rfe) {  
System.out.println("Raster format error: " + rfe.getMessage());
```



```
private static void createClip(BufferedImage img, Dimension size,  
int clipX, int clipY) throws Exception {
```

```
    boolean isClipAreaAdjusted = false;
```

```
    if (clipX < 0) {
```

```
        clipX = 0;
```

```
        isClipAreaAdjusted = true;
```

```
    }
```

```
    if (clipY < 0) {
```

```
        clipY = 0;
```

```
        isClipAreaAdjusted = true;
```

```
    }
```

```
    if ((size.width + clipX) <= img.getWidth()
```

```
        && (size.height + clipY) <= img.getHeight()) {
```

```
        clip = new Rectangle(size);
```

```
        clip.x = clipX;
```

```
        clip.y = clipY;
```

```
    } else {
```

```
if ((size.width + clipX) > img.getWidth())
size.width = img.getWidth() - clipX;

if ((size.height + clipY) > img.getHeight())
size.height = img.getHeight() - clipY;

clip = new Rectangle(size);
clip.x = clipX;
clip.y = clipY;

isClipAreaAdjusted = true;

}

if (isClipAreaAdjusted)
System.out.println("Crop Area Lied Outside The Image."
+ " Adjusted The Clip Rectangle\n");
}

public static BufferedImage readImage(String fileLocation) {
BufferedImage img = null;
try {
```

```
BufferedImage img = null;
try {
img = ImageIO.read(new File(fileLocation));
System.out.println("Image Read. Image Dimension: " + img.getWidth()
+ "w X " + img.getHeight() + "h");
} catch (IOException e) {
e.printStackTrace();
}
```



```
return img;
}
```

```
public static void writeImage(BufferedImage img, String fileLocation,
String extension) {
try {
BufferedImage bi = img;
File outputfile = new File(fileLocation);
ImageIO.write(bi, extension, outputfile);
} catch (IOException e) {
e.printStackTrace();
}
}

int x=0;int y=0;

int P2=x ,Q2=y;
double pixelX;
double pixelY;
```

```

for (int i=1; i>=f;++i)
{
f=(P2-Q2);

}

pixelX = Math.sqrt(f) ;
    pixelY = Math.sqrt(f) ;

    int pixelx = f ;
        int pixely = f ;
Kernel kernel = new Kernel(3, 3, new float[]
{
0.24f, 0.24f, 0.24f,
-1.24f, 5.5f, -1.24f,
-1.24f, 1.24f, -1.24f});

long endTime = System.currentTimeMillis();

System.out.println(" The execution time of Algorithm took: " + (endTime - startTime) + "
Milliseconds");

Imagelcon icon3 = new Imagelcon("img1/1.png");

JOptionPane.showMessageDialog(null, new JLabel("***Welcome to Smart Detection System of
Vehicles License Plate by using Segmentation and enhancement Image technique** Press OK to
Continue... ", icon3, JLabel.LEFT));

Imagelcon icon = new Imagelcon("img/1.jpg");

JOptionPane.showMessageDialog(null, new JLabel("The Car Image Dimension has been Reading
Press OK to Continue...", icon, JLabel.LEFT));

```

```
JOptionPane.showMessageDialog(null, new JLabel("The Car Image Dimension has been Reading  
Press OK to Continue...", icon, JLabel.LEFT));
```

```
ImageIcon icon2 = new ImageIcon("img/Plate.jpg");
```

```
JOptionPane.showMessageDialog(null, new JLabel("The Car Plate image has been Printing and  
The execute speed of Algorithm ( time ) is: ( " + (endTime - startTime) + " Milliseconds) ", icon2,  
JLabel.LEFT));
```

```
ImageIcon icon1 = new ImageIcon ("img1/3.png");
```

```
JOptionPane.showMessageDialog(null, new JLabel(" This Program by: OMER JAMAL KAMIL KAMIL  
*** Department of INFORMATION TECHNOLOGIES *** ", icon1, JLabel.LEFT));
```

```
}
```

```
}, pixelxy);
```

```
}
```

```
}
```

```
.....End of Code.....
```

```
import java.awt.Dimension;
import java.awt.Rectangle;
import java.awt.image.BufferedImage;
import java.awt.image.RasterFormatException;
import java.io.File;
import java.io.IOException;

import javax.imageio.ImageIO;

public class QAA {

    static Rectangle clip;

    public static void main(String args[]) throws Exception {
        String inputFileLocation = "img/1.jpg";
        String outputFileLocation = "img/Plate.jpg";

        System.out.println("Reading Original File : " + inputFileLocation);

        BufferedImage originalImage = readImage(inputFileLocation);

        /**
         * Image Cropping Parameters pixelStartY
         */

        BufferedImage processedImage = cropMyImage(originalImage, pixelWidth,
        pixelHeight, pixelStartX, pixelStartY);
```

```
System.out.println("Writing the Recognition Plate image to: "  
+ outputFileLocation);  
writeImage(processedImage, outputFileLocation, "jpg");  
System.out.println("...Done");  
}
```

```
public static BufferedImage cropMyImage(BufferedImage img, int pixelWidth,  
int pixelHeight, int pixelStartX, int pixelStartY) throws Exception {  
    BufferedImage RecognitionPlate = null;  
    Dimension size = new Dimension(pixelWidth, pixelHeight);  
  
    createClip(img, size, pixelStartX, pixelStartY);  
  
    try {  
        int w = clip.width;  
        int h = clip.height;  
  
        System.out.println("Recognition Plate Width " + w);  
        System.out.println("Recognition Plate Height " + h);  
        System.out.println("Recognition Plate Location " + "(" + clip.x + "," + clip.y
```

```
RecognitionPlate = img.getSubimage(clip.x, clip.y, w, h);
```

```
System.out.println("Image Recognition. New Image Dimension: "  
+ RecognitionPlate.getWidth() + "w X " + RecognitionPlate.getHeight() + "h");  
} catch (RasterFormatException rfe) {  
System.out.println("Raster format error: " + rfe.getMessage());
```

```
RecognitionPlate = img.getSubimage(clip.x, clip.y, w, h);
```

```
System.out.println("Image Recognition. New Image Dimension: "  
+ RecognitionPlate.getWidth() + "w X " + RecognitionPlate.getHeight() + "h");  
} catch (RasterFormatException rfe) {  
System.out.println("Raster format error: " + rfe.getMessage());
```



```
private static void createClip(BufferedImage img, Dimension size,  
int clipX, int clipY) throws Exception {
```

```
    boolean isClipAreaAdjusted = false;
```

```
    if (clipX < 0) {
```

```
        clipX = 0;
```

```
        isClipAreaAdjusted = true;
```

```
    }
```

```
    if (clipY < 0) {
```

```
        clipY = 0;
```

```
        isClipAreaAdjusted = true;
```

```
    }
```

```
    if ((size.width + clipX) <= img.getWidth()
```

```
        && (size.height + clipY) <= img.getHeight()) {
```

```
        clip = new Rectangle(size);
```

```
        clip.x = clipX;
```

```
        clip.y = clipY;
```

```
    } else {
```

```
if ((size.width + clipX) > img.getWidth())
size.width = img.getWidth() - clipX;

if ((size.height + clipY) > img.getHeight())
size.height = img.getHeight() - clipY;

clip = new Rectangle(size);
clip.x = clipX;
clip.y = clipY;

isClipAreaAdjusted = true;

}

if (isClipAreaAdjusted)
System.out.println("Crop Area Lied Outside The Image."
+ " Adjusted The Clip Rectangle\n");
}

public static BufferedImage readImage(String fileLocation) {
BufferedImage img = null;
try {
```

```
BufferedImage img = null;
try {
img = ImageIO.read(new File(fileLocation));
System.out.println("Image Read. Image Dimension: " + img.getWidth()
+ "w X " + img.getHeight() + "h");
} catch (IOException e) {
e.printStackTrace();
}
```



```
return img;
}
```

```
public static void writeImage(BufferedImage img, String fileLocation,
String extension) {
try {
BufferedImage bi = img;
File outputfile = new File(fileLocation);
ImageIO.write(bi, extension, outputfile);
} catch (IOException e) {
e.printStackTrace();
}
}

int x=0;int y=0;

int P2=x ,Q2=y;
double pixelX;
double pixelY;
```

```

for (int i=1; i>=f;++i)
{
f=(P2-Q2);

}

pixelX = Math.sqrt(f) ;
    pixelY = Math.sqrt(f) ;

    int pixelx = f ;
        int pixely = f ;
Kernel kernel = new Kernel(3, 3, new float[]
{
0.24f, 0.24f, 0.24f,
-1.24f, 5.5f, -1.24f,
-1.24f, 1.24f, -1.24f});

long endTime = System.currentTimeMillis();

System.out.println(" The execution time of Algorithm took: " + (endTime - startTime) + "
Milliseconds");

Imagelcon icon3 = new Imagelcon("img1/1.png");

JOptionPane.showMessageDialog(null, new JLabel("***Welcome to Smart Detection System of
Vehicles License Plate by using Segmentation and enhancement Image technique** Press OK to
Continue... ", icon3, JLabel.LEFT));

Imagelcon icon = new Imagelcon("img/1.jpg");

JOptionPane.showMessageDialog(null, new JLabel("The Car Image Dimension has been Reading
Press OK to Continue...", icon, JLabel.LEFT));

```

```
JOptionPane.showMessageDialog(null, new JLabel("The Car Image Dimension has been Reading  
Press OK to Continue...", icon, JLabel.LEFT));
```

```
ImageIcon icon2 = new ImageIcon("img/Plate.jpg");
```

```
JOptionPane.showMessageDialog(null, new JLabel("The Car Plate image has been Printing and  
The execute speed of Algorithm ( time ) is: ( " + (endTime - startTime) + " Milliseconds) ", icon2,  
JLabel.LEFT));
```

```
ImageIcon icon1 = new ImageIcon ("img1/3.png");
```

```
JOptionPane.showMessageDialog(null, new JLabel(" This Program by: OMER JAMAL KAMIL KAMIL  
*** Department of INFORMATION TECHNOLOGIES *** ", icon1, JLabel.LEFT));
```

```
}
```

```
}, pixelxy);
```

```
}
```

```
}
```

```
.....End of Code.....
```