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License Plate Recognition using Connected Components and Morphological Processes

C. Aravindan
Asst. Professor, Dept. of ECE,
SRM Institute of Science & Technology,
Ramapuram, Chennai, India

Rahul Nair
B.Tech Student, Dept. of ECE,
SRM Institute of Science & Technology,
Ramapuram, Chennai, India

Suman Saha
B.Tech Student, Dept. of ECE,
SRM Institute of Science & Technology,
Ramapuram, Chennai, India

Ashwin Sairam
B.Tech Student, Dept. of ECE,
SRM Institute of Science & Technology,
Ramapuram, Chennai, India

Tharun Prakash
B.Tech Student, Dept. of ECE,
SRM Institute of Science & Technology,
Ramapuram, Chennai, India

Sneha Sreekumar
B.Tech Student, Dept. of ECE,
SRM Institute of Science & Technology,
Ramapuram, Chennai, India

Abstract **- The project presents license detection framework utilizing associated part investigation and layout coordinating model for precise distinguishing proof. License Plate Recognition extracts vehicle number from a picture. The framework display utilizes a captured picture for this detection procedure. Firstly, the acknowledgment framework begins with character recognizable proof dependent on number plate extraction, Splitting characters and format coordinating. Plate Recognition as a genuine application needs to rapidly and effectively process tags under various natural circumstances, for example, day time. It assumes a vital job in various genuine applications, for example, programmed toll gathering, transit regulation implementation, parking area get to control, and street traffic observing. The framework utilizes diverse layouts for recognizing the characters from caught picture. After character acknowledgment, a recognized gathering of characters are contrasted with database number tags for confirmation. Morphological procedure results in division of the picture and prepared for further correlation with information base picture. Here we are utilizing neural network for the examination of the input image with database image and it in turn results in whether the number plate is authenticated or unauthenticated.**

Keywords-Morphological, Neural, Framework

I. INTRODUCTION

Programmed license plate recognition assumes an essential job in various uses, for example, unattended parking, garages, security of confined regions, transit regulation implementation blockage evaluating and programmed toll accumulation. Because of various workplaces, LPR strategies differ from application wise. Cameras capture dynamic scenes while moving, skillet or zoom. In addition, when they do show up in a picture, license tags may have subjective sizes, introductions and positions. In case complex foundations are included, recognizing license plates may turn out to be a significant test. Regularly, a LPR procedure comprises of two fundamental stages (1) finding license plates, (2) distinguishing license numbers. In the main stage, license plate are resolved dependent on the highlights of license plates. Highlights generally utilized have been gotten from the license plate design and the alphanumeric characters establishing license numbers. The highlights with respect to License plate group incorporate shape, symmetry stature to width proportion shading surface of grayness spatial recurrence and change of power esteems Character highlights incorporate line mass the sign progress of slope extents, the viewpoint proportion of characters the circulation of interims among characters and The arrangement of characters. As a general rule, a little arrangement of powerful, solid, and simple to-identify object highlights would be satisfactory. The license plate applicants decided in the finding stage are inspected in the license number recognizable proof stage. There are two noteworthy assignments associated with the ID organize, Number division and Number recognition. Number partition has in the past been practiced by such strategies as projection morphology unwinding marking, associated segments and mass shading. Since the projection technique expect the introduction of a license plate is known and the morphology strategy requires knowing the sizes of characters. A half breed of associated segments and mass

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shading procedures is considered for character detachment. Bolster Vector machine Markov forms and limited automata these techniques can be extensively characterized into iterative and Noniterative methodologies. There is a tradeoff between these two Groups of methodologies; iterative strategies accomplish better precision, yet at the expense of expanded time multifaceted nature. For this, we built up our very own character recognition system, which depends on the controls of both fake neural systems and mechanics.

II. RELATED WORKS

This paper is devoted to a License Plate Recognition (LPR) framework for moving vehicles by utilizing vehicle camcorder. The proposed LPR technique primarily comprises of preprocessing, plate area, and character division and acknowledgment. At first, the conceivable locales of number plate are upgraded from the caught pictures through the proposed edge discovery strategy and slope based binarization. At that point, the right plate districts are chosen by dissecting the flat projection and the corner appropriation. A vertical Sobel preparing is performed on the fragmented tag area and afterward the proposed weighted-binarization strategy is utilized to portion each character of the permit, trailed by the skew revision. At long last, a probabilistic neural system (PNN) method is connected to perceive each portioned character. Test results demonstrate that the precision rates of License area and License Recognition can accomplish 91.7% and 88.5%, separately.With the utilization of Internet of things in the field of transportation, the prerequisite of traffic control and wellbeing the board is expanding, the clever transportation has turned into the principle course of traffic the board. Tag acknowledgment innovation is the utilization of video picture acknowledgment innovation, and it is a vital piece of smart transportation framework. The development of vehicle permit extraction from complex foundation and recognized, extricated by the tag picture preprocessing, highlight extraction, tag character acknowledgment innovation to distinguish the vehicle evaluation, shading and other data. In the rush hour gridlock stream recognition, control and direction, the air terminal, the port, private vehicle the executives, don't stop electronic toll collection(ETC), running red light and other unlawful vehicle checking and vehicle hostile to burglary, and so forth., has wide application prospects. In this paper, the format coordinating is utilized to manage the tag picture, area of the tag territory, character division and acknowledgment, the tilt plate acknowledgment rate of 90%, subsequent to utilizing Radon change remedy, acknowledgment rate of up to 95%, has a decent impact.

Recently, in another paper it has been stated that number plate verification has three phases, including tag confinement, character division, and character acknowledgment. In spite of the fact that the tag acknowledgment framework has been effectively connected to nature controlled savvy stopping framework, despite everything it faces many testing in the observation framework, for example, clogged traffic with numerous plates, vague signs and notices, tilting plates, just as dark pictures taken in awful climate and evening time. In this paper, we propose a productive License Plate Recognition System that initially distinguishes vehicles and after that recovers tags from vehicles to decrease false positives on plate recognition. At that point, we apply convolution neural systems to improve the character acknowledgment of obscured and cloud pictures. The test results demonstrate the prevalence of the execution in both precision and execution in correlation with conventional tag acknowledgment frameworks.

III. PROBLEM STATEMENT

License plate recognition (LPR) is the innovation for recognizable proof of license plate numbers from a video stream or a picture without human communication. LPR has numerous applications, for example toll checkpoints, and parking garages, pursuit and following identification of stolen vehicles, catch of guilty parties, and different guidelines and so forth. There are numerous methodologies utilized in contemporary ALPR frameworks that utilization diverse picture handling procedures and AI calculations for detection. These frameworks show considerable consequences of detection on information with high goals and quality. Be that as it may, these frameworks experience troubles of recognition because of halfway impediments, not uniform light, filthy plates, and undesirable components. Also, the kinds of license plates shift by various nations and here and there even by districts. Along these lines, numerous ALPR frameworks require explicit ways to deal with achieve high recognition rates. In this work, we consider distinctive methodologies of LPR and give our methodology of license plate check strategy which exhibits promising outcomes.

Fig 1: Rain water causing speckles in the number plate

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Fig 2: Smog causing blur image

IV. MODULE DESCRIPTION

The flow diagram in Fig. 3 explains the complete process that takes place in the system.

The captured image is fed to the system which goes through several preprocesses like image smoothening, sharpening, debluring etc. Once these processes are over the system extracts the region of interest(ROI). The region of interest consists of the number plate. Segmentation is performed on the number plate consisting of the characters. Once segmentation takes place the system is able to identify the characters individually and as a whole the vehicles number is obtained. The next process is matching the vehicle number against the database. The final step is the decision making step where the system informs the user whether the vehicles number is authenticated or not. Based upon the decision of the system the result could be implemented in large number of applications.

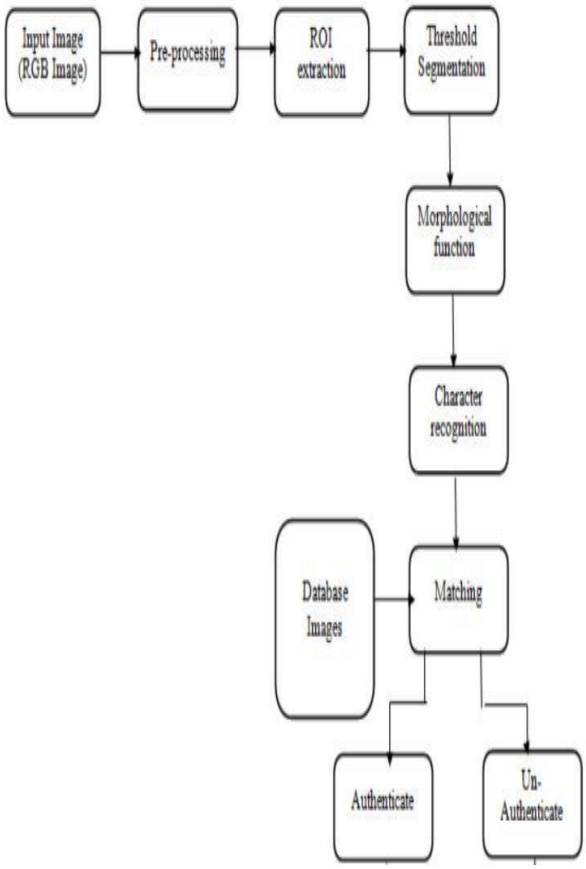

Fig 3: Flow Diagram of the System

4.1 PREPROCESSING

The preprocessing is a step of smoothening, sharpening, debluring the captured image in order to remove the dots, speckles, stains etc.

4.1.1 IMAGE SMOOTHENING

Image smoothening is performed by using the following 3 steps:

i) Averaging Filter- Here, each pixel is replaced by the average of the neighbouring pixels in a square window. In this process a larger window is considered. Although the larger window can efficiently remove noise but at the same time blurs the image.

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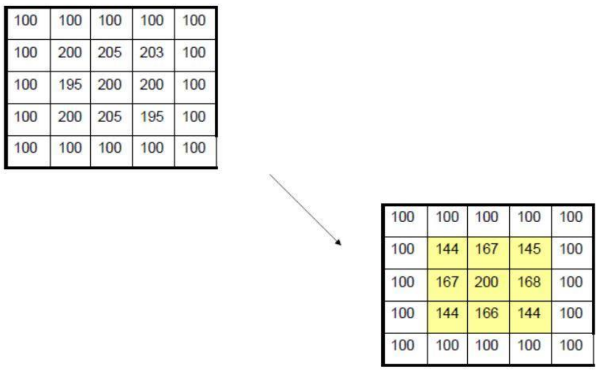

Fig 4: 3x3 Average Filter

ii) Weighted Averaging Filter- Here, instead of implementing average weighting, priority is set. The near by pixels are given higher weightage whereas the far pixels are given lower weightage. The Weighted Average filter holds low frequency and stifles the high frequency.

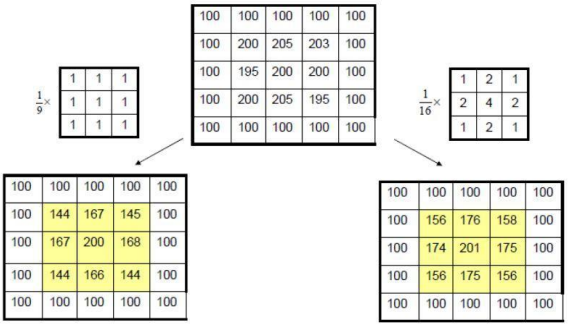

Fig 5: Weighted Average Filter

iii) Median Filter- While the usage of average filter results in blur images and at the same time inefficient for impulse response, the median filter overcomes these issues.

The median filter sorts the pixels in low to high order. It is not mandatory for the window to be square. Exceptional shapes can obtain the line structures.

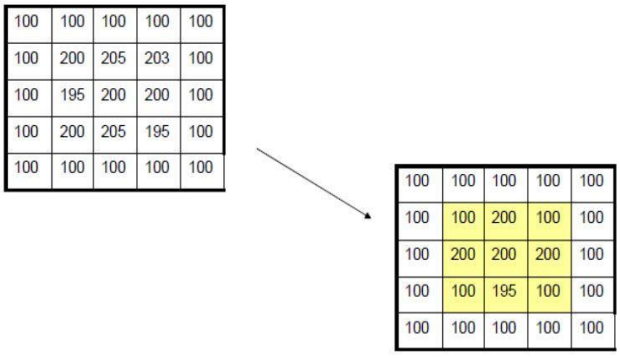

Fig 6: 3x3 Median Filter

4.1.2 IMAGE SHARPENING

It is used to upgrade the line structures and other informations in an image.

The upgraded image can be considered as a sum of the actual image and the scaled version of the corners and line structures. This process could be performed using a high pass filter. Combined operation is a average weighted filter where weights could be negative and the sum is 1.

4.1.3 IMAGE DEBLURRING

Often the captured image could be blurred due to the moving vehicle. Thus in order to perform the further step, it is important to obtain a deblurred or clear image. The deblurred image could be obtained by the following steps-

I) Inverse Filter
II) Weiner Filter

4.2 SEGMENTATION

The aim of segmentation is to rearrange or potentially change the portrayal of a picture to a progressively significant and simpler to dissectable substance. In other words, image segmentation is the path toward doling out an imprint to every pixel in a picture to such a degree, that pixels with a comparable name share certain visual characteristics.. The aftereffect of segmentation is a lot of sections that all in all spread the whole image, or a lot of forms removed from the image. Here we use Optimal Threshold Value method, the following are the steps:

(1) Let, initial threshold T= (highest value of image brightness + the lowest value of the image brightness)/2
(2) Set B and N where B are pixel values are lower than T and where N are pixel values are higher than T.
(3) Individually calculate the mean of B and N.
(4) Find new threshold: Tn= (b+n)/2
(5) Rehash the second means to the fourth step unless the iterative conditions are obtained.
Thus, finally Ts=Tn-T

4.3 MORPHOLOGICAL FUNCTIONS

4.3.1 MATHEMATICAL MORPHOLOGY

Mathematical morphology (MM) is a hypothesis and procedure for the investigation and handling of geometrical structures, in view of set hypothesis, grid hypothesis, topology, and arbitrary capacities. MM is most ordinarily connected to advanced images, however it tends to be utilized too on charts, surface lattices, solids, and numerous other spatial structures.

Topological and geometrical space ideas, for example, estimate, structure, convexity, network, and geodesic separation etc. MM is additionally the establishment of morphological image handling, which comprises of a lot

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of administrators that change images as indicated by the above portrayals.
It was initially produced for parallel images, and was later stretched out to grayscale capacities and images. The consequent speculation to finish grids is generally acknowledged today as MM's hypothetical establishment.

4.3.2 BINARY MORPHOLOGY
The fundamental thought with binary morphology is to test a picture with a straightforward, pre-characterized structure, reaching determinations on the way the structure maps or misses the structure in the image. This straightforward "test" is known as Structuring Element and is a binary image that is a subset of the network.

i) EROSION

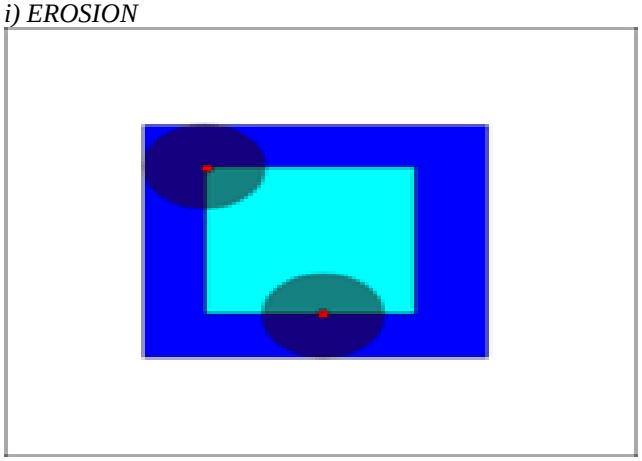

Fig 7: Erosion

The erosion of the dull blue square by a plate, bringing about the light-blue square.
Erosion of binary picture A by the organizing component B characterized as:

$$A \ominus B = \{z \in E | B_z \subseteq A\}$$

where B_z is the translation of B by the vector z

$$B_z = \{b + z | b \in B\}, \forall z \in E.$$

ii) DILATION

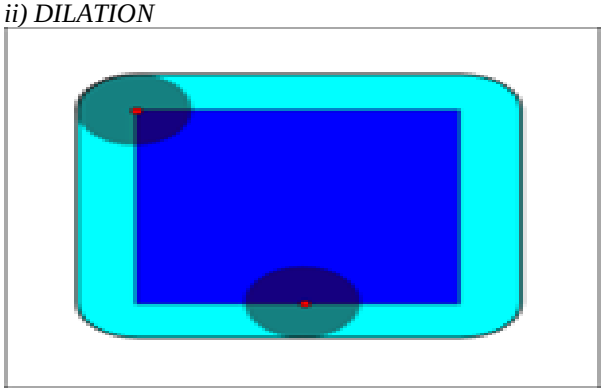

Fig 8: Dilation

The dilation of the dull blue square by a plate, bringing about the light-blue square with adjusted corners. The dilation of A by the organizing component B is characterized by:

$$A \oplus B = \bigcup_{b \in B} A_b \; A \oplus B = B \oplus A = \bigcup_{a \in A} B_a$$

;

The dilation can also be obtained by:

$$A \oplus B = \{z \in E | (B^s)_z \cap A \neq \varnothing\}$$

,where B^s denotes the symmetric of B, that is,

$$B^s = \{x \in E | -x \in B\}.$$

iii) OPENING

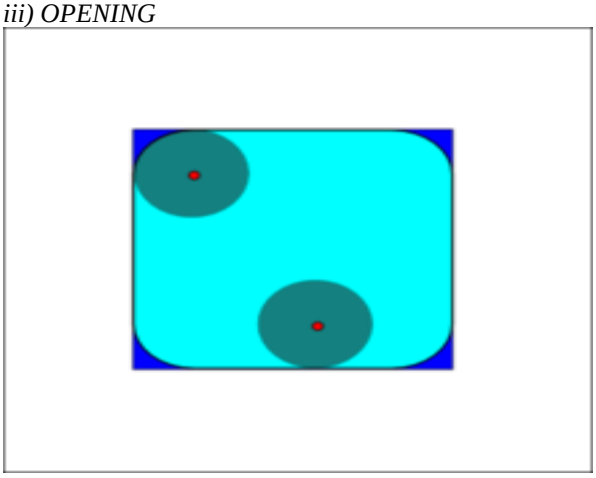

Fig 9: Opening

The opening of the dull blue square by a plate, bringing about the light-blue square with round corners.
The opening of A by B is acquired by the disintegration of A by B, trailed by widening of the subsequent picture by B:

$$A \circ B = (A \ominus B) \oplus B$$

iv) CLOSING

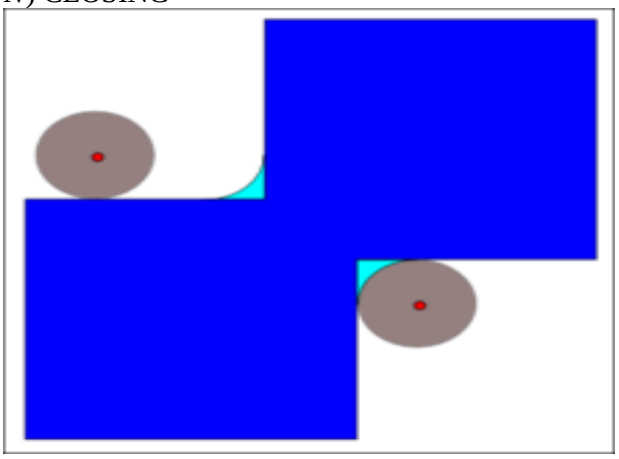

Fig 10: Closing

The closing of the dark-blue shape by a disk, resulting in the union of the dark-blue shape and the light-blue areas. The closing of A by B is obtained by the dilation of A by

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B, followed by erosion of the resulting structure by B: $A \bullet B = (A \oplus B) \ominus B$.

The closing can also be obtained by $A \bullet B = (A^c \circ B^s)^c$ where X^c denotes the complement of X relative to E. The above implies that the closing is the supplement of the locus of interpretations of the symmetric of the organizing component outside the picture A.

NEURAL NETWORK

PROBABILISTIC NEURAL NETWORK

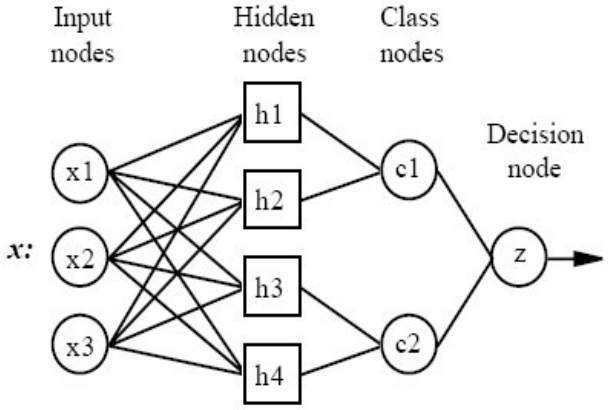

Fig 11: PNN Architecture

The network used in our project is given as:

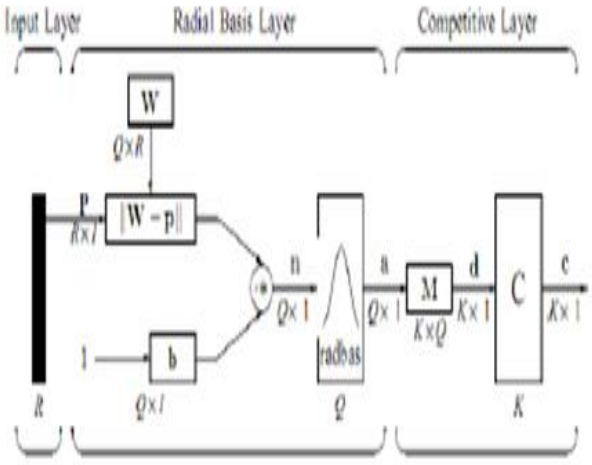

Fig 12: Proposed PNN Network

PNN WORKING

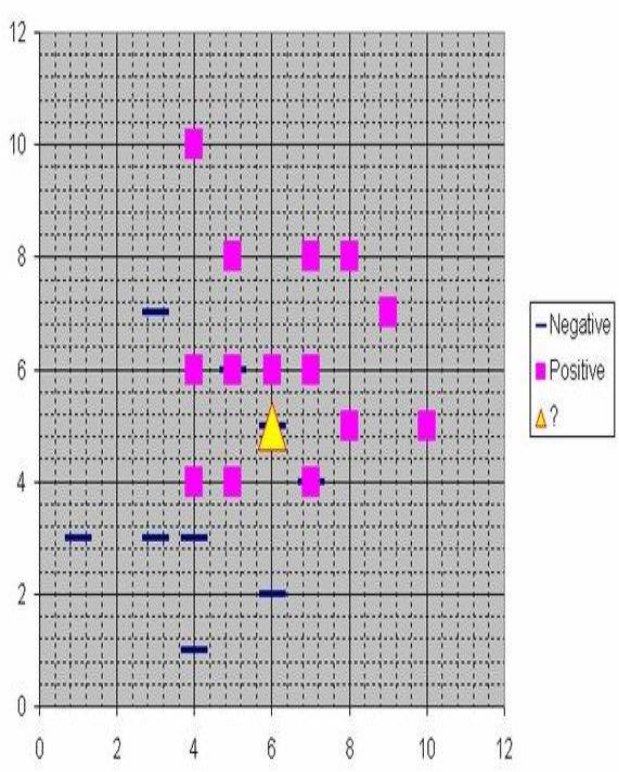

Fig 13: PNN Working

The essential thought is that an anticipated target estimation of a thing is probably going to be about equivalent to different things that have close estimations of the indicator factors.

Expect that all situation in the preparation set has two indicator factors, x and y. The cases are plotted utilizing their x, y facilitates as appeared in the diagram. Additionally accept that the objective variable has two classifications, positive which is signified using square and negative using dash. Presently, assume we are attempting to foresee the estimation of another case spoken to by the triangle with indicator esteems x=6, y=5.1.

Notice that the triangle is position precisely over a dash speaking to a negative esteem. In any case, that dash is in a genuinely irregular position contrasted with alternate dashes which are grouped beneath the squares and left of focus. So it may be the case that the basic negative esteem is an odd case.

The closest neighbour characterization performed for this model relies upon what number of neighboring focuses are considered. On the off chance that 1-NN is utilized and just the nearest point is considered, at that point unmistakably the new point ought to be named negative since it is over a known negative point. Then again, if 9-NN order is utilized and the nearest 9 points are

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considered, at that point the impact of the encompassing 8 positive focuses may overbalance the nearby negative point.

A probabilistic neural system expands on this establishment and sums it up to think about the majority of alternate focuses. The distance is figured from the fact of the matter being assessed to every one of alternate focuses, and a spiral premise work (RBF) (likewise called a part work) is connected to the distance to register the weight (impact) for each point. The outspread premise work is so named on the grounds that the sweep distance is the contention to the capacity.

PNN is basically used to remove unnecessary neurons. The following are the benefits:

i) The model's size is decreased.
ii) Application time amid scoring is decreased.
iii) Neuron removal frequently increases the model's precision.

The way toward expelling pointless neurons is a repeitive process. Leave one out is utilized to quantify the model's mistake with every neuron dismissed. The neuron that results minimal increment in blunder (or potentially the biggest decrease in mistake) is next expelled. The procedure is continued with the rest of the neurons until the stopping criteria is acheived.

PNNs are utilized for grouping issues. The PNN classifier introduced great precision, extremely little preparing time, strength to weight changes, unimportant retraining time. There are six phases associated with the proposed model which are beginning from the information contribution to yield. The primary stage is ought to be the picture preparing framework. Fundamentally in picture preparing framework, image procurement and picture improvement are the means that need to do. In this paper, these two stages are skipped and every one of the images are gathered from available sources. The proposed model requires changing over the image into a configuration fit for being controlled by the PC. The MR images are changed over into grids structure by utilizing MATLAB. At that point, the PNN is utilized to order the MR images. In conclusion, execution dependent on the outcome will be broke down toward the finish of the improvement stage

VI. EXPERIMENTAL RESULT

The first step of the system is to update the database. On completion a dialog box appears stating the successful update of the database.

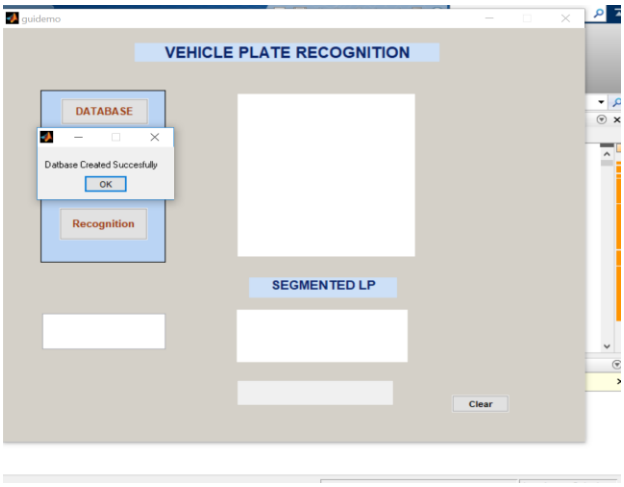

Fig 14: Database Update

In the second step, the captured image is fed to the system using the 'Browse' push button.

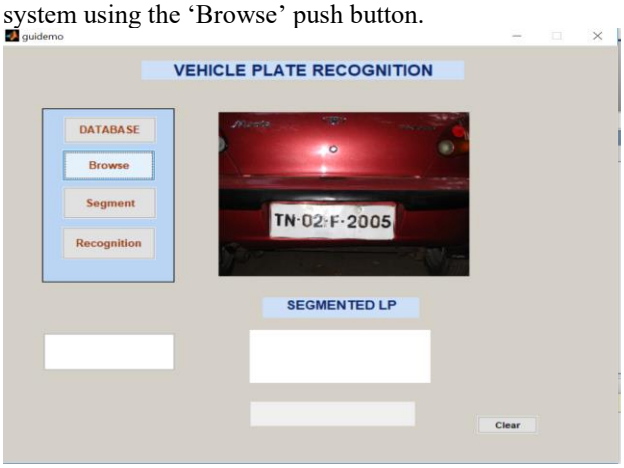

Fig 15: Browsed Image

Next, the image is segmented which extracts the region of interest.

Fig 16: Segmentation

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Finally, the vehicle number is checked against the database using the recognition option.

Fig 17: Recognition

Here, the vehicle's number exists in the database thus, the system verdicts the vehicle as authenticated.
Again, we have another example:

Fig 18: Browsed Image

Captured image fed into the database.

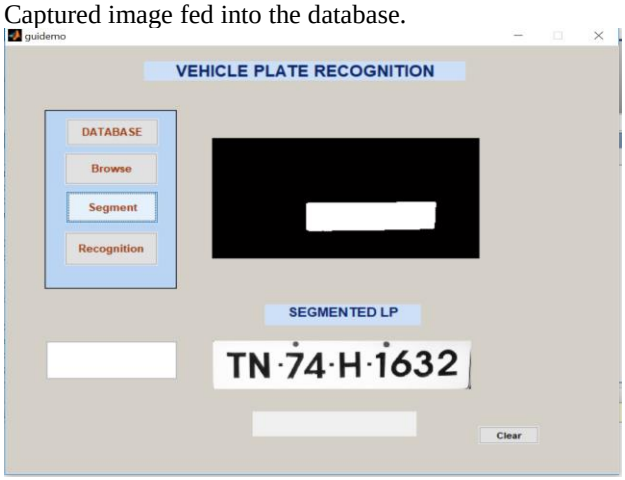

Fig 19: Segmentation

The region of interest is extracted.

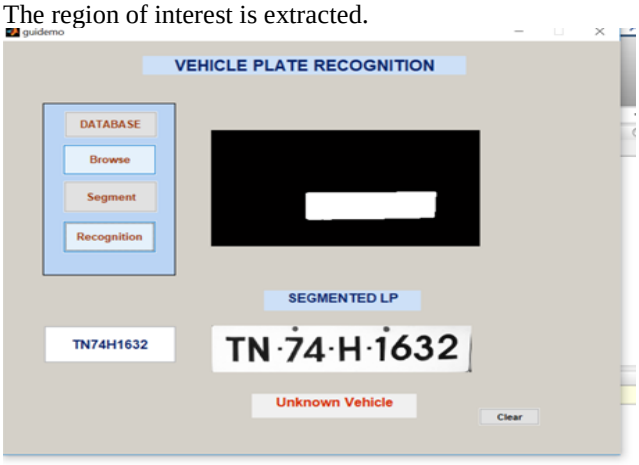

Fig 20: Recognition

After recognition process, it is found that the vehicle number is not present in the database, thus the system makes a decision that the vehicle is unknown or unauthenticated.

VII. CONCLUSION

In this paper, we have been successfully able to develop a method by means of which we can automatically detect the number plate of a vehicle and also evaluate whether the vehicle is authenticated or not. Alongside this, the system has several other application like toll collection, parking charge collection etc. The captured image is fed to the system which checks for the number plate against the database and decides the authentication of the system.

VIII. FUTURE SCOPE

The future scope of the paper is largely application based. This includes making the system extremely fast resulting in ease of usage. Apart from that, large number of applications can be lined up using different types of recording processes like lane crossing violation, cell phone usage restrictions etc.

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