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Character Recognition of Vehicle License Plate using Feature Extraction: A Review Paper

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Abstract: ***The License Plate Recognition (LPR) system is the most popular method for the mass surveillance of the automobiles now days. The LPR system is basically works into 3 steps , 1st step is to recognize vehicle license plate and then extract numbers from that and third step is to character recognition means to read out the characters of an number plate. The LPR is also some face some difficulties due to no uniform structure of number plates and illumination is also cause some difficulties in some areas. The techniques developed until are mostly relied on some fixed parameters like a fixed image capturing angle and proper illumination and stationary background condition. These all techniques are varied on different factory like the processing time for an license number plate and the power consumption and its accuracy and error free results. This LPR system gives an new vision in the intelligent transport system which open a new way for the automobile industry towards a intelligent automobile world. Still being there are some researches are carried out to develop the LPR technique in terms of process complications.***
Keywords: Open Character Recognition, LPR, MLP, Accuracy, Radial Basis Function.

I. INTRODUCTION

From the past two decades there is an boom in the automobile industry which increase the number of vehicles on road and make the transportation faster and cheaper. Till now human are employed for monitoring and controlling the traffic related parameter which is very difficult and very complex. Thus the developed countries are now opting a intelligent transport system to monitor the traffic. The main aim to design these intelligent systems is to monitor the vehicle more accurately and to construct a applicable scheme to control the traffic [1, 2]. License plate recognition system is an integral part of these intelligent transport systems, the license plate recognition techniques makes it possible to use image processing technique to extract the alphanumeric numbers from the vehicle license number plates and to read out the plate.

This techniques makes possible to recognize the number plate numbers from an moving or an stationary vehicle which makes vehicle recognition more easier. This technique is employed for various kind of uses like to automatic charge the toll fees from the vehicle owner while he passing from a toll way and to recognize the vehicle who breaks the traffic rules and to recognize the drivers who breaks the traffic rules to punish them. This technique also uses to recognize the vehicles that are involved in any offenses like kidnapping etc. these all are the applications of a LPR technique [3-5].

To design a classifieds for the character recognition we mainly match the templates of different specifications. To match the template by a automatic method we first set some sample templates and then we obtain some character from these templates. Then the character obtained from these templates is compare with the sample templates and the template which is closely matching with the sample templates is consider as an result of character recognition.

As if the license plates are standardized means there size and the font uses in character is fixed then it's become much easier to recognize the character but this process is slow and time consuming and this method is not feasible in real environment [6-8]. In the field of plate recognition, the most commonly used classifier is ANN [9].

To get the maximum efficient results from these neural networks we have to choose the appropriate number of hidden layers and number of neurons.

Now a day's , various types of multilayer NN are being applied for the character recognition eg. RBF, Kohonen, ART etc. apart from all these types of multilayer neural network the MLP is the most attention seeking neural network and gaining more popularity due to its easy structure and it can be trained easily and quick to use.

Apart from these advantages there is also two disadvantages of this MLP network [7-9]. This technique is employed for various kind of uses like to automatic charge the toll fees from the vehicle owner while he passing from a toll way and to recognize the vehicle who breaks the traffic rules and in parking allocation systems [8, 9].

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These kind of intelligent system become more important when the automotive industry is going towards an intelligent vehicles world and smart roads.

In such kind of application the system recognize the character from the license number plate and recognize it and makes system to works in an movable and variable environment where conditions become changing. There are also various challenges for these systems like illuminations, environmental factors.

Although these task are become easier for the human but its not practical to apply it at big scale. Till now we can not apply a fully automated transport system in non-ideal environmental conditions [10].

Generally, an LPR system consists of three subsystems. Optical character recognition, Character extraction and License Plate Detection. The image containing a license plate will be first processed by the LPD system, once the location of the license plate in the image is found, the CE system will extract the characters from the license plate. The character will be recognized after the information is processed by the OCR system.

Imperfect images create challenges for the OCR recognition process [11].

In this paper, we reviewed various techniques offered by the different expert to enhanced the recognition rate. In this scheme we use MLP neural network schemes which act as building blocks for this architecture [8-12].

The input for the LPR is the binary vectors which we obtain from the licensed number plates. In our scheme we use unidirectional image detectors and kirschedge detector for the feature extraction.

We can extract these features at very much low cost by the help of computational techniques and get acceptable results for the character recognition [10-13].

This research is divided into five sections: I section gives the basic introduction, II section gives the literature review, III section gives information about problem formulation, IV section giver performance parameters and V section gives the result of this paper.

II. LITERATURE REVIEW

This section will provide the brief description and highlights the contribution, remarks and factors of the work done by the researchers. Many attempts have been made in the past to achieve the maximum accuracy while segmented the images.

Zied Selmiet.al highlighted about LP segmentation methodology that is used to compare the simulation results by an estimated result which is generated by an algorithmic method which is LP recognition, character recognition. Precision Rate, Recall Rate & F-Score were achieved up to 93.80%, 91.30% and 92.01% respectively [1].

Ana Riza F et.al highlighted about KNN Algorithm is used. In this Gaussian & tricube kernels are used. The average run time of the model was 0.034 per frame. Recognition rate for single neural network & artificial neural network was 87.43% & 86.34 % respectively. The plate recognition system using KNN in real-time was effective [2].

Liu Panet.al proposed about Convolution Neural Network. In this method, License character degradation and segmentation of character were defined. A data set of 481 images was studied. Correctness is defined in term of rank. Rank is given as 0.5031, 0.6778, 0.7630and 0.8274 respectively. Low quality license plate character recognized with this method [3]

Sun Yuzheet.al proposed sampling based on classic shape context algorithm and simplified free man chain code. Recognition accuracy was achieved up to 92.7 % [4].

Mansour Nejatet.al described about Kirsch edge operator and image projection for featureextraction classified using mixture of experts which uses the multilayer perceptron (MLPs) as expert. A Data Set of12000 Images are used The recognition rate was achieved up to 99.68 % .

Two topology expert & gating was used as learning rate [5]. Wang Yutaoet.al described hybrid technique related Wavelet Transformation and Generalized Regression neural Network. Recognition Rate of Letter Character, Mixed letter and latin Character was achieved upto 93.4 % ,91.9 % and 98.8 %[6].

Yuan Jingi et.al proposed different OCR Method. These OCR methods include artificial neural network, probabilistic neural network and Self-Organizing Neural Network. Recognition Accuracy for ANN , Probabilistic ANN and Self-Organizing ANN: 95.1% , 89.1 % and 95.6 % respectively[7].

Dickson NeohTze et.al highlighted about Deep Convolution Neural Network Multilayer Perceptron for MLP-3 & MLP-6 algorithm. Convolution Neural Network for CNN-3 & CNN-6. Recognition Rate with MLP-3 , MLP-6 ,CNN-4 and CNN-6 algorithm was achieved up to 99.7 % , 99.89 % , 99.69 % and 99.91 % respectively. The networks can be trained on computer characters and can be made to recognize characters from real images of license plate characters with reasonable accuracy [8].

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TABLE: 1 Literature Review Table

Reference	Paper Title	Research Methodology used	Major Findings	Research prospects
[1]	Deep Learning System for Automatic License Plate Detection and Recognition	LP segmentation It includes 1. LP Detection 2. Character Segmentation 3. Character Segmentation 4. Character Recognition	Precision Rate : 93.80 % Recall Rate : 91.30 % F-Score : 92.01 %	A deep learning architecture represented by a CNN model in both LP detection and recognition.
[2]	A KNN based approach for the Machine Vision of Character Recognition of License Plate Numbers	KNN Algorithm is used. Gaussian & tricube kernels are used. 30 License Plates are analyzed.	K Range : 0-10 Accuracy : 60% -90% Accuracy 1 NN : 87.43% ANN : 86.34% Average Run Time : 0.034 per frame	Different frames were processed for longer than 0.03 seconds, which were compensated by fast processing times of other frames. As such, it can be said that the plate recognition system using kNN in real-time was effective.
[3]	Low-quality License Plate Character Recognition Based on CNN	Convolution Neural Network is used. License character degradation, Segmentation of characters	Data Base : 481 pictures Correctness of classification in terms of rank rank(1) = 0.5031, rank(3) = 0.6778, rank(5) = 0.7630, rank(10)= 0.8274.	The proposed method can help recognize the low-quality license plate character of the actual surveillance videos, and reach a desirable recognition rate..
[4]	License Plate Character Recognition Research Based on Shape Context	1. Freeman chain code 2. Sampling based on the simplified Freeman chain code 3. Description of the classic shape context algorithm 4. Shape Matching	Recognition Accuracy : 92.7 %	The proposed method can identify similar characters effectively with a certain degree of differentiation.
[5]	Iranian License Plate Character Recognition Using Mixture of MLP Experts	Directional image projections and directional Kirsch edge operators for feature extraction classified using mixture of experts which uses the multilayer perceptrons (MLPs) as expert	Data Set : 12000 Images Recognition Rate: 99.68 %. Topology Expert : 90:30:25 Gating : 99:7:3 Learning Rate Experts : 0.5 Gating : 0.1	Recognition performance comparison between the mixture of three MLPs with a single MLP reveals that a mixture structure was much more reliable at solving a difficult classification problem.
[6]	Recognition of License Plate Character Based on Wavelet Transform and Generalized Regression Neural Network	Hybrid Method based on Wavelet Transformation and Generalized Regression neural Network.	Recognition Rate Letter Character : 93.4 % Mixed Character : 91.9 % Chinese Character : 98.8 %	Experiments show that the classification algorithm proposed in the paper has good generalization ability and learning efficiency.
[7]	An Efficient FPGA Implementation of Optical Character Recognition for License Plate Recognition	Different OCR Method are used 1. Artificial Neural Network 2. Probabilistic Neural Network 3. Self-Organizing Neural Network	Recognition Accuracy ANN : 95.1% Probabilistic ANN : 89.1 % Self-Organizing ANN : 95.6 %	The higher recognition accuracy is due to the proper setup and selection of network size, and the optimized and efficient setup of the neuron activation function..
[8]	Character Recognition of Malaysian Vehicle License Plate with Deep Convolutional Neural Networks	Deep Convolution Neural Network Multilayer Perceptron for MLP-3 & MLP-6 Convolution Neural Network for CNN-3 & CNN-6	Recognition Rate MLP-3 : 99.7 % MLP-6 : 99.89 % CNN-4 : 99.69 % CNN-6 : 99.91 %	The networks can be trained on computer characters and can be made to recognize characters from real images of license plate characters with reasonable accuracy..

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III. PROBLEM FORMULATION

While degrading the obtained image there are various problems comes which effects the other applications like image localization, extraction , understanding the scene . The methods which are uses now a days are only used for the blurred images and they cannot be employed for the original images restoration, and did not use for the practical applications [12]:

There are various factors for the degradation of license plate which are used for the original videos. This cannot be feasible to obtain image which is based on these factors. If an image have various number of degradation factors then this become much difficult to find the right degradation parameters. .

This problem cannot solve by past method as , restoration and resolution.

In this paper, we solve this issue with a new idea. Here we are not restoring any image but low quality images categories using machine learning method and classification [12-15].

IV. PERFORMANCE PARAMETERS

The performance of segmentation is measure with Precision rate, Recall rate and F-Score.

1) *False Positives (FP):* These are the different regions in the image which are detected by algorithm as text and these are also actually text [13].
2) *False Negatives (FN):* These are the different regions in the image which are not detected by algorithm as text but there are actually text present [13].
3) *Precision rate (p):* It is defined as the average ratio of images which are detected without any error to the summation of the image correctly detected and images which are not detected or false negatives. It is given as [13]:

$$P = \frac{Correctly\ detected\ character}{correctly\ detected\ character+FP}$$

4) *RRC (Recall rate)* = It is the percentage ratio of extracted character in image to the total character in an image [13].

RRC= (No. of extracted characters text in image / No. of characters text in image) x 100.

5) *F-score:* It is the harmonic mean of the recall rate and precision rates
6) *Accuracy:* The accuracy of a test is completely based on the capability of the test to distinguish the patient and healthy cases efficiently. To compute the accuracy of an system we calculate the ration of true positive and true negatives in all the performed cases. Mathematically, this can be stated as [14]:

$$\text{Accuracy} = \frac{TP+TN}{TP+TN+FP+FN}$$

V. CONCLUSION

In this study various License Plate Recognition techniques has been discussed in details which were used by many researcher. The License Plate Recognition (LPR) System mainly contains the three major steps of Region of Interest Extraction, License Plate Extraction, and Character Recognition using number of different techniques which are disused in paper clearly. License plate recognition is challenging in case of different weather conditions and differ number plate formats. There are number of LPR techniques purposed in previous years.

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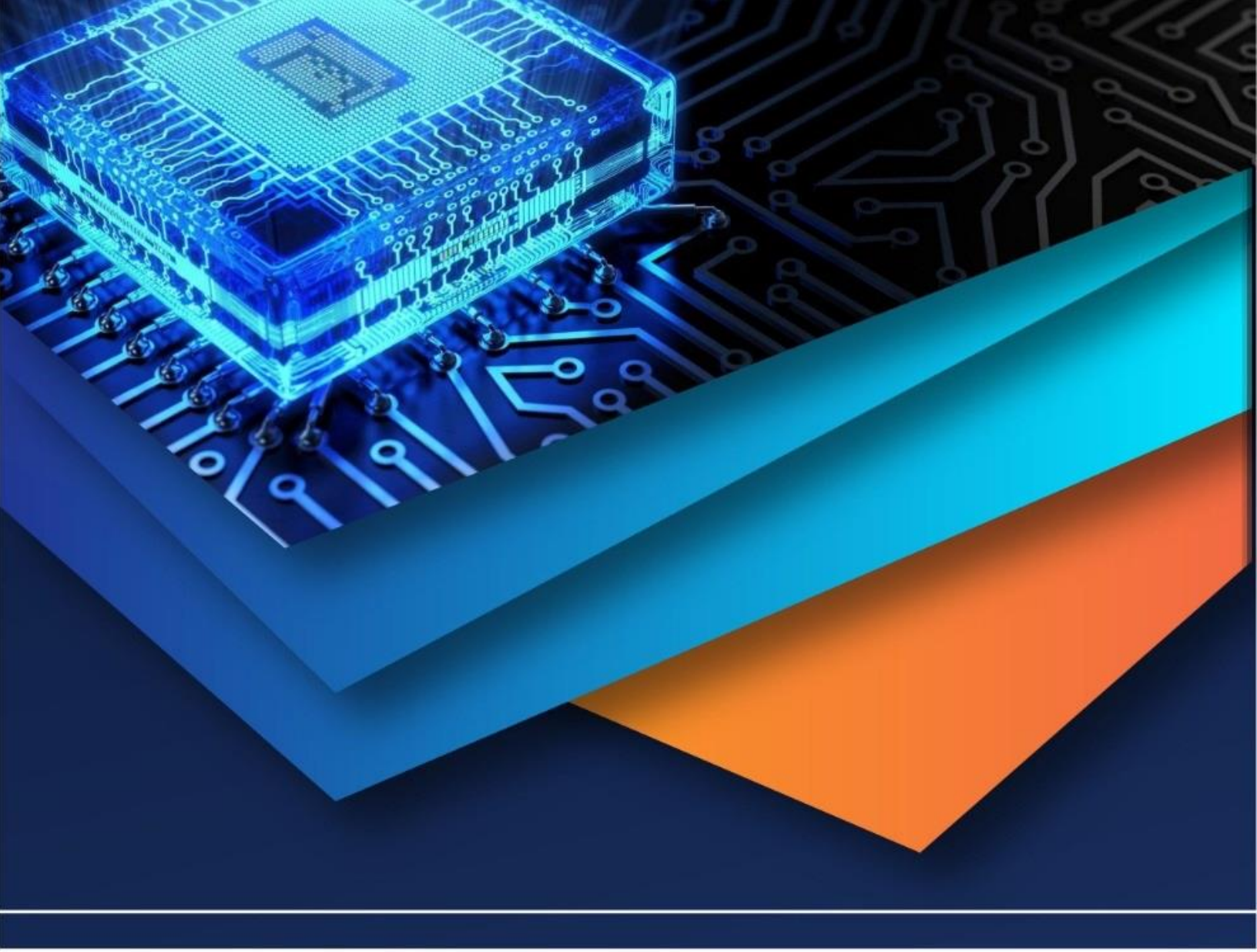

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