Licence Number Plate Recognition System with Suitable Learning Rate: A Survey

Stuti Asthana[1], Dinesh Goyal[2] and Amitkant Pandit[3]

[1]Ph.D. Research Scholar, CSE Department, [2]Principal, Gyan Vihar School of Engineering & Technology Suresh Gyan Vihar University,Jaipur, Rajasthan, India.[3]Professor, ECE Department, Shri Mata Vaishno Devi University, Katra, Jammu, India

Abstract: *Automatic Number plate recognition system is method or technology in which optical character recognition is used on an image to read vehicle number plate. With the help of OCR we can convert handwritten, typewritten or printed text electronically into machine editable form. With the help of Automatic Number plate recognition system we can identify the number plate of every moving vehicle on the traffic signal. For this purpose many approaches has been developed, but still every year many progressing involved in techniques. The basic steps involve in each Automatic Number plate recognition system are vehicle image capture, Number plate detection, character segmentation and character recognition. In this paper, we attempt to review different techniques of number plate recognition and their usage.*

Keywords: Automatic Vehicle Number Plate Recognition, Neural Network, Character Segmentation.

1. Introduction

The licence plate recognition system is same as automatic number plate recognition system. The automatic number plate recognition system was invented in UK police scientific development branch in the year of 1976. In the last few years it gained more interest with computational capability and capture image quality improvement. This system is automatically extract and recognize vehicle number plate from an image. For this purpose it contain a camera or frame grabber which is used for capture an image to find the location of the number in the image and extract the character for character recognition tool to convert the picture in to arithmetic readable character . It can be used to identify and avoid criminal actions and for security control of limited area like military zones or area around top government office [1].
For many Analysis like crime recognition system, traffic detecting system and stolen vehicle detection automatic number plate recognition is an very valuable research. The complete recognition system is divided into five segments: first part is image acquisition means capture the license plate image, second is pre-processing the image, third is localizing the license plate forth is character segmentation i.e. locating and identifying the individual symbol images on the plate and fifth is optical character recognition. This is the basic structure of automatic number plate recognition which is remaining same. The general format of the license plate is starting two letters which is used for state code followed by district code, and then a four digit code is specifically used for particular vehicle.

2. Five Steps for Automatic Number Plate Recognition System

A. Image acquisition: Image acquisition in this research means capture the license plate image.

B. Pre-processing of Image: Preprocessing is used to enhance the captured image which is used for third step. For preprocessing purpose minimum filter is applied on an image to keep the image dark. Preprocessing consist of 2 steps: first is binarization and noise removal.

C. Binarization: In binarization input image is converted into form of zeo and one means gray level image from RGB image format.

D. Noise Removal: In noise removal stage noise has eliminated from the image so that sharpness of image can be preserved. After the noise removal from the Number Plate, we use the optical character recogniser(OCR) which include the Segmentation, Feature extraction and Number plate Recognition. Then Gray scale image are transformed into binary image by using some threshold value then elimination of noise.

E. Localization of image: In this phase, the license plate location has identified and the sub image is extracted that contains only the license plate. This step consists of two steps: A rectangle is located over the license plate. In this step a box that contains the license plate is located (this rectangle may also has some extra parts from the four sides), and this rectangle work as the input to the next step for further processing (removing the extra parts, character segmentation then recognition) [2].

Formative the exact location of the license plate. Using the sub-image from the last step which contains the license plate with some extra parts (if any), the following processing is applied to this sub-image.

The license plate may be tilted because of the angle of the camera while image acquisition process. And it is very important to de-skew the plate to its original orientation, thus making the plate aligned with the X and Y axes (The reason behind its importance will be clear below). So a Hough transform is applied to the horizontally edge detected image in order to find the shear parameters by which the image can be de-skewed to retrieve the standard orientation [2], [3][4].

Image Segmentation: In automatic number plate recognition, image Segmentation is very important step, because all progressive steps depend on this step. If segmentation has not done properly, a character cannot be properly divided in to parts, or two characters can be improperly merged together. For that purpose horizontal projection can be used for a number plate for the segmentation, or can be segmentation using the neural networks. For this purpose any one method can be used in two methods:

1. Horizontal segmentation
2. Vertical segmentation.

To find the character from the plate First we have vertically segmented character find out by performed vertical segmentation on the number plate. To acquire the character from the plate, After performing vertical segmentation we have to perform horizontal segmentation.

Character recognition: By the use of Classification method we can uses the feature extracted from the previous step to recognise the characters. The feature extraction is a process of transformation of data into the machine editable form. The recognition of character should be invariant towards the user font type, or deformations caused by a tilt.

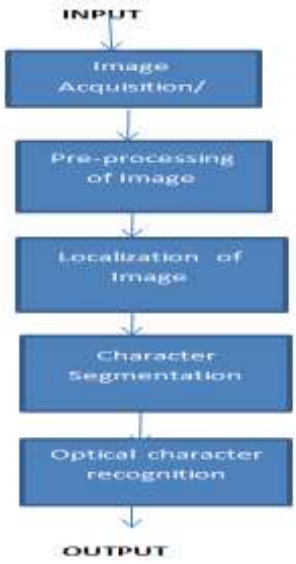

Figure 1: Five basic steps for Automatic number plate recognition system

3.Literature Survey

L. Fletcher et.al. [6]Made a research for pruning the number of hidden layer neurons in an artificial neural network. An algorithm has been implanted which is based on singular value decomposition of the conditional information matrix and uses likelihood ration test statistics as selection criteria for elimination of neurons. Various training sessions were executed in order to prune the number of hidden layers neurons. The main limitation of this algorithm is that exact calculations of the number of neurons is not possible in a single attempt and also time consuming because of several sessions of training and eliminating hidden layer neurons.

Somehow the work is better than hit and trail approach where user generate an architecture of neural network which consist of either less or more number of hidden layer neurons then the necessary one.
Afterwards eliminating or increasing the number of neurons and analyzing on the expected outcome will rectify the problem slowly and finally nearby value of desired neurons can be achieved.

Gnana Sheela K and Dr. S N Deepa [7]analyzed momentum concept of neural network in her paper. While designing any BPNN, some factor should be kept in mind that how many neurons are considered in Input layer, hidden layer and Output layer. Along with that few parameters like learning rate (alpha) and momentum also plays a vital role in designing best performance BPNN. The learning rate is denoted by alpha and varies from 0 to 1. It helps in controlling the weight adjustment. If the learning rate is high then the network training time is less but the accuracy will not be best. If it is kept less than the training time then training time will be more and accuracy will be satisfactory.

So in order to precisely specify the architecture, another parameter momentum is introduced which smoothens the weight adjustment and also reduces cross stitching. So overall combination of both momentum and learning rate should be considered so that best performance of BPNN can be achieved.
David Hunter et. al. [8], in this paper, various level parity problems has been solved by using multiple hidden layer.
Also, this has been revealed that more complex parity problem can be solved with the use of 2 or 3 hidden layer approach. However the architecture is performing best when three hidden layer are used.
The drawback is that by increasing the layers, the number of weights are also increased which in turn increases the complexity of the network.
The approximation of this dissertation work is considered from Shinichi Tamura and Masahiko [9]which states that training will be better in multiple hidden layers. They implemented two hidden layer and three hidden layer to a common problem so as to compare the performance of the neural network.

In this work a three layer in which one input layer with N input neurons, one hidden layer with N-1 neurons and one output layer with one neurons is taken under consideration and performance comparison is done with a four layered feed forward neural network which one input layer with N neurons, two hidden layer with N/2 +3 Neurons and one output layer. It has been proves in this paper that two hidden layer architecture is superior in many parameter. The main advantage is achieved in training phase of input target pairs. Overall accuracy is increased by this.

Many Researchers elaborate the answer of this question that which size and structure is required for Multilayer Perceptron to approximately run any sufficiently smooth function .

As with the favor of [9], Prasanna Kumar Muthukumar and Alan W Black [10]also presented their work which proves that with the use of three hidden layer the result performance has been increased as compared to single or dual hidden layer. Here in this paper the speech synthesis of different/multiple languages are done with three hidden layer and the results are awesome.

4. Conclusion

With survey we found that hidden layers number with suitable number of nurons is directly depend on the number of epochs. This means if number of hidden layers increase then training time also increases or in other word we can say that network training process has slow down. If the correctness of the results is a serious factor for an ANPR application, then the network having many hidden layers should be used but if training time is a serious factor then the network having single hidden layer (with sufficient number of neurons) must be used.

References

1. J. Sharma, A Mishra, K. Saxena and S. Kumar , “A Hybrid Technique for License Plate Recognition Based on Feature Selection of Wavelet Transform and Artificial Neural Network”, International Conference on Reliability, Optimization and Information Technology, 2014.Okamura HM, Ouchi M. Self-compacting concrete. J Adv Concr Technol 2003; 1(1):5–15.
2. O. Martinsky, Algorithmic And Mathematical Principles Of Automatic Number Plate Recognition Systems, B.Sc. thesis, Department of Intelligent Systems, Faculty of Information Technology, Brno University of Technology (2007).
3. B.D. Acosta, Experiments in image segmentation for automatic US license plate recognition, M.Sc. thesis, Department of Computer Science, Faculty of the Virginia Polytechnic Institute and State University (2004).
4. H. Sarukhanyan, S. Alaverdyan, and G. Petrosyan, Automatic Number Plate Recognition System, Proceedings of the 7th International Conference on Computer Science and Information Technologies, Yerevan, Armenia, September 28-2 October, 2009, Electronic Copy of the CSIT 2009 Proceedings, 347-350
5. Zhen-Xue Chen, Cheng-Yun Liu, Fa-Liang Chang, and Guo-You Wang, "Automatic License-Plate Location and Recognition Based on Feature Saliance," IEEE Transactions on Vehicular Technology, vol. 58, no. 7, pp. 3781-3785, 2009.
6. Fletcher, L. ; South Africa Univ., Pretoria, South Africa ; Katkovnik, V. ; Steffens, F.E. ; Engelbrecht, A.P., “Optimizing the number of hidden nodes of a feed forward artificial neural network” IEEE orld Congress on Computational Intelligence. The 1998 IEEE International Joint Conference on Neural Networks Proceedings, 1998. (Volume:2)
7. K. Gnana Sheela, Dr. S.N. Deepa, “Analysis of computing algorithm using momentum in neural networks”, Journal of Computing, Volume 3, Issue 6, pp.163-166, 2011.
8. Hunter, D, Hao Yu ; Pukish, M.S. ; Kolbusz, J. “Selection of Proper Neural Network Sizes and

Architectures—A Comparative Study" IEEE Transactions on Industrial Informatics (Volume:8 , Issue: 2) 228 – 240, May 2012.

9. Shin' ichi Tamura and Masahiko, " Capabilities of a Four Layered Feed Forward Neural Network: Four layer versus three. IEEE transactions on Neural Network, 8, 251-255, 1997.
10. Prasanna Kumar Muthukumar and Alan W Black, "Automatic discovery of a phonetic inventory for unwritten languages for statistical speech synthesis",DOI: 10.1109/ICASSP.2014.6854069 Conference: ICASSP 2014 - 2014 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)