GLRLM Based Texture Feature Extraction Technique and Neural Network Technique for ANPR: Possible Use, Study and Comparision

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ABSTRACT-Automatic Number Plate Recognition (ANPR) and detection has become an important area of research because of the unlimited increase of vehicles and transportation systems which make it impossible for humans to fully manage and monitor it. Vehicle number plate recognition and detection is a technique that is used in most of the traffic related applications e.g. searching of stolen cars, law enforcement, managing highway electronic toll collection points, red light violation enforcement, border and customs checkpoints, etc. The system works when the vehicle passes an ANPR camera and its number plate is captured and instantly checked against the database records of vehicles of interest. There are various techniques to detect the number plate automatically e.g. Segmentation, distance and color invariants, Feature extraction, Neural Networks etc. In this paper, an attempt is made to study a possible use of Gray Level Run Length Matrix (GLRLM) based feature extraction technique for ANPR and present its brief comparison with Neural Network based ANPR.

Key words: *ANPR, Database, Feature extraction, Segmentation, Neural Network etc.*

INTRODUCTION

Automatic vehicle number plate recognition is an essential aspect of intelligent traffic management system. Vehicles play an important role in transportation. The identification of a vehicle is important for highway toll fee, for payment of parking fee, crime prevention and so on. Since the number of vehicles are increasing day by day thus it is difficult for humans to identify the vehicles manually, thus automatic number plate recognition is required. Since a number plate is the unique identification of vehicle therefore it is effective attribute for vehicle recognition. ANPR is also known by various other terms number plate tracking, car plate recognition, automatic vehicle identification etc**.** ANPR works in three steps: capturing image, number plate extraction and recognition. There are various techniques used for vehicle number plate recognition. Number of researches have been carried out for car identification based on car number plate extracting and recognition, few of which are: Lotufo, Morgan and Johnson[1] : proposed automatic number-plate recognition using optical character recognition techniques. Johnson and Bird[2] : proposed knowledge guided boundary following and template matching for automatic vehicle identification. Fahmy[3]:discussed about the potential of using the **BAM** Neural Network for number plate reading. It's appropriate for small numbers of patterns. This approach uses edge enhancement techniques with a boundary making to extract the car number plate and character classification by BAM Neural Network. Nijhuis, ter Brugge and Helmholf[4] proposed fuzzy logic and Neural Networks for car number plate recognition based on Dutch number plate. This method used fuzzy logic for segmentation and discrete-time cellular Neural Networks (DTCNN'S) for feature extraction. Choi[5] and Kim[6] proposed the method based on vertical edge using Hough transform (HT) to extracting of car number plate. This is assumed that only a number plate has vertical edges in front image of a car. Since many car images have vertical edges from a radiator, also using HT is very sensitive to deformation of plate boundaries , and it needs much processing time. E.R. Lee, P.K. Kim and H.J. Kim[7] using Neural Network for color extraction and a template matching to recognize characters. S.K. Kim , D.W. Kim and H.J. Kim[8] using a genetic algorithm based segmentation to extract the plate region , but it's time consuming method. H.J. Kim, D.W. Kim , S.K. Kim , J.V. Lee and J.K. Lee[9] proposed a method of extracting a car number plate region based on color image segmentation by distributed genetic. But this method requires much processing time. In this paper we will study the possible us of GLRLM based texture feature extraction technique for ANPR and also present a comparative study between the two techniques of ANPR viz: GLRLM based feature extraction and Neural Network technique.

OBJECTIVES

1. To study the possible use of GLRLM texture feature extraction technique for automatic number plate recognition system.
2. To study the number plate recognition system using artificial Neural Network technique.
3. Comparatives study on the above mentioned technique

LITERATURE SURVEY

Automatic Number Plate Recognition (ANPR) is an image processing technology which uses number plate to identify the vehicle. The objective is to design an efficient automatic authorized vehicle identification system by using the vehicle number plate. The system is implemented at the entrance points for security control of highly restricted areas like military zones or area around top government offices e.g. Parliament, Supreme Court etc. Muhammad Tahir Qadir in his paper proposed that a Vehicle number plate region is extracted using the image segmentation in an image. Optical character recognition technique is used for the character recognition. The resulting data is then used to compare with the records on a database so as to come up with the specific information like the vehicle's owner, place of registration, address, etc. The system is implemented and simulated in Matlab, and it performance is tested on real image. It is observed from the experiment that the developed system successfully detects and recognize the vehicle number plate on real images[10]. Prathamesh Kulkarni proposed in his paper entitled "Automatic Number Plate Recognition (ANPR) System for Indian conditions", In his paper, the task of recognizing number plate for Indian conditions is considered, where number plate standards are rarely followed. The system consists of integration of algorithms like: 'Feature-based number plate Localization' for locating the number plate, 'Image Scissoring' for character segmentation and statistical feature extraction for character recognition; which are specifically designed for Indian number plates. The system can recognize single and double line number plates under widely varying illumination conditions with a success rate of about 82%.[11]

TEXTURE FEATURE EXTARCTION USING GLRLM.

Texture is one of the most important characteristics of an image. It is used to describe the local spatial variations in image brightness which is related to image properties such as coarseness, and regularity. This is achieved by performing numerical manipulation of digitized images to get quantitative measurements. Normally texture analysis can be grouped into four categories: model-based, statistical-based, structural-based and transform-based methods. Model-based methods are based on the concept of predicting pixel values based on a mathematical model. Statistical methods describe the image using pure numerical analysis of pixel intensity values. Structural approaches seek to understand the hierarchal structure of the image. Transform approaches generally perform some kind of modification to the image, obtaining a new "Response" image and then analyzing it as a representative proxy for the original image. This paper only focuses on statistical approaches, which represent texture with features that depend on relationships between the grey levels of the image. In this paper an attempt is made to formulate an idea of recognizing the number plate by extracting features using Gray level run length method (GLRLM).The preprocessed image may be utilized to construct the feature sets using Gray-Level Run-Length Method (GLRLM). And then each features set may be used for the classification. Gray-Level Run-Length Matrix Texture is understood as a pattern of grey intensity pixel in a particular direction from the reference pixel. In texture feature extraction the GLRLM features for each sample can be extracted using MATLAB function.

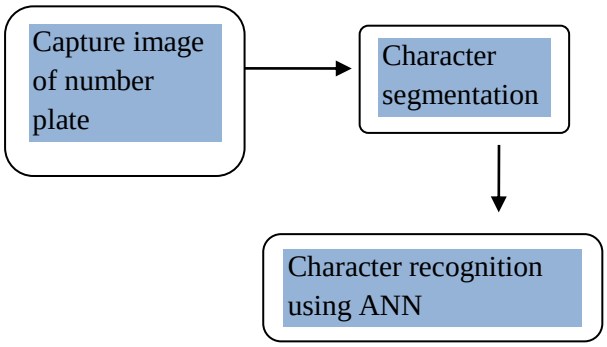
Matlab scripts may be used to detect the two dimensional gray level run length matrix for each sample image may be calculated and their seven GLRLM features viz short run emphasis(SRE), long run emphasis(LRE),grey level non-uniformity(GLN),run length non-uniformity(RLN), run percentage(RP),low grey level run emphasis(LGLRE),high grey level run emphasis(HGLRE) may be obtained. To check the efficiency of the features which may be extracted and to find a suitable feature vector for classification we may use statistical measure like mean and standard deviation. The mean(μ) and standard deviation(σ) of each of seven features for training sample of every individual sample may be calculated. The mean of feature LRE, RP ,RLN may show a large discrepancy between samples of different number plates but for a particular sample r LRE , RP, RLN of all the training samples was in the range $\mu \pm \sigma$. LRE ,RP, RLN feature may showed a large inter personal variation and a very small intra personal variation among the other 4 features thus a potential features to verify a particular sample as genuine or forgery. Measuring the similarity or distance between two samples in feature space is essential for classification. Euclidean distance classifier may be used. This is a simple distance between a pair of vectors. Here LRE, RP, RLN features can be taken as vectors. Euclidean distance classifier can be used for verification process. The final results may be obtained by finding the false acceptance rate (FAR), false rejection rate(FRR) and equal error rates (ERR) at different threshold values. The threshold can be adjusted as per the application requirement whether a higher FAR or FRR is acceptable because these parameters are inversely proportional to each other. There is no single set of FAR and FRR specifications useful for all different applications. If the system is specified for very high security situations such as military installations then FAR may be chosen to be very low else for typical customer applications such as for automatic teller machines cannot afford to alienate users with such a high FRR therefore the choice in these applications is low FRR at the sacrifice of higher FAR. The choice of the threshold value is made easier by determining the Equal Error Rate (EER). As the name implies, EER is the value where the FAR and the FRR overlaps and the value is equal for both rate. The EER of a system may be used to give a threshold independent performance measure. The lower the EER is, the better may be the system's performance, as the total error rate which is the sum of the FAR and the FRR at the point of the EER decreases.

RECOGNITION USING NEURAL NETWORK

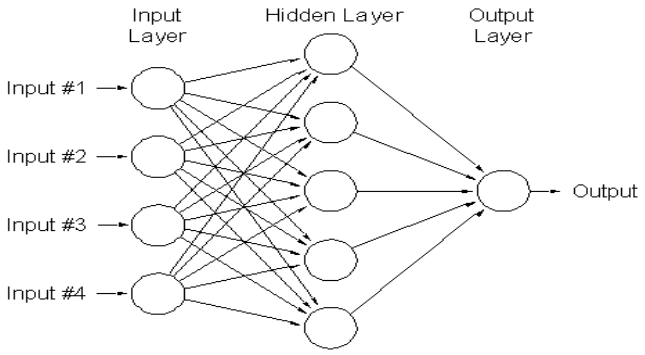
Another technique used for number plate recognition is based on artificial Neural Networks. Although the initial functionality of this system is similar with the other techniques but the main steps involved in it are :

1. Number plate detection
2. Character segmentation
3. Character recognition

Figure below shows the high level model of number plate recognition using Neural Networks.



Number plate is detected by first capturing the image of the number plate. After this the captured image is processed to scissor the individual characters .This process is known as segmentation. There are various methods of segmentation like template matching and projection based segmentation ,blob extraction, combination of projection and inherent characteristics of a character ,Projection based method, image scissoring method ,Morphological and partition based method[14]. Finally the character recognition is done by using ANN. Neural networks are simplified computational models of the biological neuron system. It is a massively parallel distributed processing system made up of highly interconnected neural computing elements known as neurons that have the ability to learn and there by acquire knowledge and make it available for use. So Neuron is basically an information processing unit that is fundamental to the operation of Neural Networks. Various learning mechanisms exist to enable the NN acquire knowledge. Neural networks basically consist of three layers which are input, hidden and output layers. The hidden layer can be more than one . These layers are interconnected through neurons by a connection known as synaptic. These synaptic are given weights which decide about the strength of the connection. Figure below gives the overview of Neural Networks.



For Character recognition, the Neural Networks are trained with all numbers which makes the number plate (Numeric's, alphabets) in there different styles. Each neuron in the input layer is fed directly to the hidden layer neurons via a series of weights. The sum of the products of the weights and the inputs is calculated in each node. The calculated values are fed directly to the output layer neurons via a series of weights. As in hidden layer, the sum of the products of the weights and the hidden layer neuron outputs is calculated in each node in the output layer. If the error between calculated output value and the desired value is more than the error ratio, then the training (changing the weights and calculating the new output by using the new weights) process begins. This training process can be finished by obtaining the desired error rate for all input combinations. For training the ANN, feed-forward back-propagation algorithm can be used. For measuring the training performance of the network, mean square error (MSE) function is used. The value of the MSE is used to determine how well the network output fits the desired output. The stop criteria for supervised training are usually based on MSE. Most often the training is set to terminate when the MSE drops to some threshold. Approaching the MSE value to the zero means that the calculated output value is becoming the closer to the desired output value[12]. Each character is matched one by one and its output is stored and the process takes another character. There are two ways of making the process to recognize the characters either by single Neural Network or by using two separate networks. Using Separate network can increase the success rate of recognition by taking numeric input in one network and character input in another network. By this way the complexity of matching the similar alphabets and numbers (like o,0) decreases.[13] .

Finally the recognized characters which are stored together are compared with the database records to check the authentication of the determined number plate.

COMPARISION OF GLRLM BASED TEXTURE FEATURE EXTRACTION AND NEURAL NETWOK BASED TECHNIQUE

Although both the techniques can be used for number plate recognition systems but they differ in their behaviors and efficacy of results. Number plate recognition using texture feature doesn't give the better results when compared to any other technique in general and Neural Network based technique in particular. Since in this technique the number plate is not segmented and the captured object is processed for feature extraction as a whole. So it has more problems of divergences from the expected results. But in number plate recognition using Neural Networks the rate of accuracy is more as its accuracy depends on the size of the database source used by the Artificial Neural Networks and by increasing the size of database the accuracy rate of Neural Networks can be increased. However, Neural network is slower because it has to be trained first with all characters and numbers in their different style. Also the number plate needs to be segmented for extracting the individual characters/numbers. When we finally have to make a choice of using any of the above discussed techniques for ANPR , Neural Networks technique shall be preferred over GLRLM based technique.

CONCLUSION

Although there are various other techniques for number plate recognition but the objective of this study was to use GLRLM based feature extraction technique for ANRP and compare the results with the ANRP based on Neural Networks. In feature extraction method, statistical approach was used, which represented texture with features that depend on relationships between the grey levels of the image. In this study, preprocessed image was utilized to construct the feature sets using Gray-Level Run-Length Method (GLRLM). And then each features set was used for the classification. In case of number plate detection using Neural Networks, the captured image is first segmented to get the individual characters and the Neural Networks are used to recognize the characters. Both the techniques can be used for automatic number plate recognition but accuracy rate in Neural Network based technique is high when compared with the feature extraction technique using GLRLM with a limitation of slower speed for achieving the results. The study has lead us to recommend Neural Networks over GLRLM for ANRP.

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