

Number Plate Recognition System Using Convolutional Neural Network

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Abstract - Every Country is facing a problem of vehicle owner and traffic control management. It is a big challenge to identify those persons who violates the traffic rules and drive vehicles fastly. It is not possible for traffic person to control such vehicles movement to identify the vehicle number due to vehicles are moving at a speed. To identify such vehicles which are not having the latest number plates and owner may be punished with some penalty. A policy which has been launched by the traffic control department all the vehicles must be equipped by the number plates associated with the chips. So that there is a need to develop a monitoring system which recognizes a number plates of the vehicles automatically. It is the best possible solution for such number plates identification. Lots of systems available for number plate recognition. Such available systems follow various methodology but still it is complex task due to parameters such as high speed, non-uniformity of the number plate, language and different lighting conditions can affect a recognition system. Majority of the systems suffers such limitations. In this paper we have discussed various approaches of the number plate system image size, success rate, and processing time as measure. We have suggested the future scope and extension of this research of the number plate system also.

Key Words - Artificial Neural Network, (OCR) Optical Character Recognition, Laplacian of Gaussian, OpenCV, GPU.

I. INTRODUCTION:

A. Automatic number Plate System

In the vehicle surveillance Number plate system licensing is the very beneficial system for last one year. Car parking system, automated system for toll money collection [3], traffic safety enforcement and parking space availability [5] all the said measures can be applied at public places. Basic major categories of the system are as follows:

Capturing of image of Vehicles (a) Detection of Number Plate (b) Segmentation of characters (c) recognition of characters. As shown in the figure the very first step is to collect the image but it is a very difficult task to capture the image of the moving vehicle in such a angel so that number on the number plates are Cleary readable [8]. Time has been fixed in capturing the image for number plate system is 45 ms in majority systems.

Identification of the fourth step depends on the previous third step and read / scan every character individually. Identification systems uses the different methods for number plate locality. Such locality system is called as super resolution [8][9]. It has been observed that quality of the system must not be compromised at all. Quality of the number plate system must be ensured [9]. We have presented the comprehensive study of the number plate system [11]. In this paper license and number plate system are the same

structured systems. Details of the system is explained in the coming section.

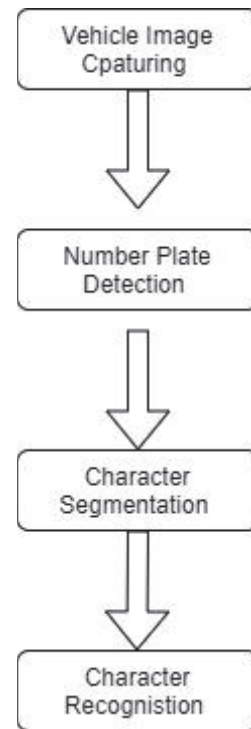


Fig. 1. Number Plate System Flow

Scope of current paper is not as a claim our approach is better than earlier approaches. We have tried to proposed one of the methods for number plate detection system. Our approach follows the steps mentioned in the figure 1. Each step of the proposed method has been surveyed properly and checked categorically manner. Speed, accuracy, performance, image size, and platform parameters are required to noted and reported properly. Our proposed approach is not dependent on the commercial survey because results/impact of the such surveys are different and realist comparatively to than theoretically approaches. Next section describes about the number plate detection system. Segmentation of characters approaches has been mentioned in the section 3 and 4. Paper describes about the facts and findings of the methods also mentioned about the limitations of the proposed method.

II. NUMBER PLATE DETECTION:

Majority of the number plate detection systems falls in to the same algorithmic manner based on the slight variation in the method adopted. Following methods must be in to under

consideration at the time of number plate detection system:

Plate Size: Every image can be of different size. plate location: There is no specific location at which number plate is to be placed. Plate Background: Background of the plate depends upon the vehicle type so that back round is of different kinds. Likewise, government vehicle carried the different background of the number plate than the public sector vehicles. [17] Screw: Available screws on the number plate system might not be considered with characters. Image segmentation method is used for number plate character extraction. Various image segmentation can be possible depends upon the character reading. Binary image segmentation is widely used. Otsu's method is also used binarization for conversion in to grey scaling. Color segmentation is also using the plate segmentation. Segmentation is discussed based on the number plate detection system [21]. Next sections explain the number plate detection system which follows the image segmentation methods has been adopted in the number plate detection system.

Image binarization is the process of conversion of the image in to black and white color codes. Black and white pixels are to be at particular threshold value. We have to careful enough at the time of selection of the correct threshold value for that image. Adaptive thresholding is the best solution. Manually threshold value can also be set or algorithmically it can also be done the process is named as automatic threshold.

Edge detection is being used for feature extraction is termed as fundamental method for the feature engineering. Connected curves with the object boundary is the difficult situation for applying the same. Canny, Canny-Deriche, Differential, Sobel, Prewitt and Roberts Cross are commonly used for edge detection for curves which are not connected with edges.

Line detection used the Hough transformation at starting of the edge detection days. Afterward research done and extension of the same has been find for extraction of the arbitrary shape like oval and circle. D.H Ballard has invented the generalized algorithm for extraction.

Points detection at various specific points and regions which differ in the color comparison to the surroundings' commonly used method is called as Blob Method. Edge detection or corner detection algorithms could not detect some complementary regions which are remained unlocated or non-detected. Laplacian of Gaussian (LoG), Difference of Gaussians (DoG), Determinant of Hessian (DoH), maximally stable extremal regions and Principal curvature are region detection methods are coming under the Blob detection algorithm.

Based on the heuristic connected components connected component analysis or blob extraction is an approach to uniquely labelled such components which are nicely connected. Current pixel condition north east, north, north west neighbor hood of the such connected pixels image is to be scanned and pixels are marked well. Connectivity types named as 4 connectivity and 8 connectivity is used for north and west neighbor. Automated image analysis is used for the optimal performance of such algorithms. Character and plate segmentation has used such analysis methods.

Lattice theory and random functions uses the mathematical morphology which is based on the set theory. Spatial structures use in special conditions and very commonly used by digitally image structures. At early stages it was meant only for the binary image processing but on extension has to be provided for the grey scale functions images also. Erosion, dilation, opening and closing

Which contains the basic operators for imaging. preceding sections are the common plate detection methods. literature discussed method are common methods for plate methods. Categorical discussion is not possible for in these types of discussions but only one approach follows in majority of the literature methods. Plate segmentation with different numbers is also been discussed here in this chapter. Sliding Concentric technique has been developed for the faster detection region of interest. Window slides with the two corners and moves from the upper left window of the image and maintains a twostep method. Segmentation rule says that the if the mean and median ration in the two of the sided windows thresholds exceeds which has been set by the central pixel of the windows and considered as regional corner of the image. When whole image has been scanned then it stops the sliding of images. Trail and error are the only methods responsible for the threshold setting.

Overall success rate has been counted as 96% in acse od connected windows. Experiment carried out at the i5 intel processor with 1 Gb Ram and took 111 ms of the processing time for plating of segmentation.

Korean number system applies for another type of SCW based systems [8]. HIS color model used for color verification and afterwards tilt was corrected by using the least mean square fitting with the perpendicular offsets. Camera and vehicle distance has to be maintained by 3 to 7 meters. Fast execution of the number detection module carried out by the cascade frame work systems [25].

Segment number plate has been used for the compact frame detection. Modular approach three modules like as a) rejection of the non-plate regions by using the gradient features. b) region and non-region plates required the three-step identification process for the plate extraction. c) Non plate regions are extracted first before the extraction of the plate verification. Number plate detection method executed at i5 intel processor unit for multiple extraction methods [17]. By the slight changes in the algorithmic parametric we can achieve the different styles of number plate systems. Skewing of the plates are also possible for the detection with different angels. Spanning of characters also checked whether characters are written in the one line or multiple lines. It has displayed in the figure clearly. Our algorithms detect up to three lined structures only. Recognition models are used to determine the characters has been written in the language, contains alphabets, characters digits and any other symbols. Alphabets can be represented as A digits are representing a D and symbols can be represented as S. Number of the Figure 2 is represented as AADAADDDDD.



Fig. 2. Character Recognition

a) Skwed image b) Number Plate with Two Lines. Localization is the method for which has been proposed for number plate system [14]. We have proposed Ostu's method which converts the grey image in to binary image.

III. PROPOSED WORK:

Plate Segmentation which is based on the dynamic programming is proposed her in this our approach [46]. We have provided the different solutions to provide the solve such algorithms [17]. Extraction of the candidate region is done by the threshed at various different levels. There are certain geometry constraints to overcome such constraints we have used blob to handle number plate detection system. Image featuring like edges, colors or any kind of lines are not required to add.

All the experiments were carried out on intel i5 processor GPU enabled system. We have also used at OpenCV for the training purpose also. Detection of number plate requires only 0.5 take time span only. Our system is quite efficient to the Korean number plates. Discipline based approach is for the segmentation of number plates. Number plates contains the colors like white, green, yellow according to the license provided. White and green, yellow plates can be detected by the edge detectors only. Colours provided by the RGB is totally formula based. Integrated maps are determined based on the plate. Noise removal is also applied to it and binarization process is used for the number plate replotting. It took only 4m sec to recognize the number. A novel future is followed by this.

IV. CHARACTER SEGMENTATION

Related work in character segmentation

Number plate has been recognized than character recognition comes in to the picture. Variety of methods are available for the character recognition. Some of the methods have been already discussed at earlier sections. Candidate region is cropped in 78* 228 pixels [5], for that bicubic interiorization has been used and proceeded for the sliding window. Threshold value 0.7 has been set for optimized results. Character reading onwards character size increases up to image size is 224. Blob method and peak coloring is not suitable for Indian number plates. CCA is very effective method for this image binary processing [9]. Image enhancement and correction are required at the early steps as a preprocessing effect of the image rectifying steps. Horizontal and vertical updating are done by the CCA.

Black characters with white base will be transformed after the resizing the images in to 224. So that all the characters could be reached at the unique size of the

imaging. Image binarization and connected components labelling can be used properly. Number of Rows BW and number of columns BW three matrices are used to solve the storage of plate location. Selection of precise location is based on the boundaries are detected which are followed by the projection. Sharpening of the image is done by the contrast. Histogram equalization is a popular method in improvement of the image contrasting by poor reflection of the image. Noisy regions have to be removed. Close and contact less regions have been detected by blob coloring method. L shaped template used for scanning the image form various locations from left to right directions. Zero valued background directions are to be used for getting the connections from all the four directions. Character extraction id achieved by the blob processing method. Characters extraction for the binary coding licensing blob coloring algorithm is applied to the same. Numbers are arranged in to the 28*35 and letters are arranged in to the 30*40. There are other algorithms are also there on Blob algorithms [14].

Blob extraction process consists the character height estimation, character width estimation. Character height estimation consists of three-parts color reversal, vertical edge detection and horizontal edge histograms. Color reversal is used to make the color of the licensed plate as black by usage of edge analysis. Finalization of number plate is done by the edge detection vertically. Binarization algorithm is used for Sobel masking. Top and bottom boundary are detected by the projection method horizontally. Height of the characters is considered as upper and lower boundaries. Image binarization and histograms in vertical position is done by the estimation of the characters width. White and Black color is done by the image binarization. Gap between the characters by the projection vertically. Process is done as the projection horizontally. Blob process consists of two step process first process contains the detection of blob checking and secondly blob detection proceeds. CCA proceeds the blob algorithm. First job is to remove the non-blob characters from the blob characters. Separation of characters is done by the clipping of characters [15]. By the process of feature extraction, classification and by the training phase of each segmented character.

V. RELATED WORK

There is method proposed for the projection improvement [25]. There is a three-step procedure for the character segmentation. In the beginning slight changes in the tilt position horizontally and vertically can be resolved. Second stage the auxiliary lines are to be drawn to make a connection between the first and last character.

Character recognition is performed by the segmentation of characters with the great accuracy. Error state in the character segmentation is major cause failure of the character recognition. CCA, vertical, horizontal is the better result producing factors of the image binarization.

VI. CHARACTER RECOGNITION

As discussed in section 2 image text is to be converted in to the editable text by the character recognition. Single number plate system method is used for these purposes.8, B and 2 and Z etc. We have observed the processing rate more than 90 % accuracy.

Segmentation algorithms worked in opposite direction on such areas like the illumination, number plate shape, size

camera distance etc. it is well proven fact that number plate algorithms work only for a few images. Segmentation processing time ranges between the 10 to 300 sec.

Lowest processing time is at 10 ms was reported higher processing time is of 1000 ms. Segmentation rate effects the characters reading which in turn overall effects the recognition. It has been proved that many methods of the number plate recognition like as binarization, sliding window concentric method, CCA, Sobel operator, Probabilistic neural networks methods got the very fruitful results about the number plate systems. Character recognition is proceeded by the image processing.

poch	Count	Step	Loss	Accuracy	val_loss	val_accuracy
Epoch 1/50	10/10	[=====]	- 65s	1s/step - loss: 0.0609 - accuracy: 0.5102 - val_loss: 0.0476 - val_accuracy: 0.6571		
Epoch 2/50	10/10	[=====]	- 3s	267ms/step - loss: 0.0435 - accuracy: 0.7329 - val_loss: 0.0386 - val_accuracy: 0.6571		
Epoch 3/50	10/10	[=====]	- 3s	270ms/step - loss: 0.0261 - accuracy: 0.5674 - val_loss: 0.0178 - val_accuracy: 0.6857		
Epoch 4/50	10/10	[=====]	- 3s	269ms/step - loss: 0.0091 - accuracy: 0.7907 - val_loss: 0.0152 - val_accuracy: 0.6286		
Epoch 5/50	10/10	[=====]	- 3s	270ms/step - loss: 0.0041 - accuracy: 0.7529 - val_loss: 0.0161 - val_accuracy: 0.6571		
Epoch 6/50	10/10	[=====]	- 3s	270ms/step - loss: 0.0028 - accuracy: 0.8640 - val_loss: 0.0163 - val_accuracy: 0.7143		
Epoch 7/50	10/10	[=====]	- 3s	270ms/step - loss: 0.0022 - accuracy: 0.9263 - val_loss: 0.0154 - val_accuracy: 0.7429		
Epoch 8/50	10/10	[=====]	- 3s	271ms/step - loss: 0.0014 - accuracy: 0.9440 - val_loss: 0.0153 - val_accuracy: 0.7143		
Epoch 9/50	10/10	[=====]	- 3s	271ms/step - loss: 9.4375e-04 - accuracy: 0.9112 - val_loss: 0.0148 - val_accuracy: 0.7143		
Epoch 10/50	10/10	[=====]	- 3s	270ms/step - loss: 9.3679e-04 - accuracy: 0.9143 - val_loss: 0.0146 - val_accuracy: 0.7714		
Epoch 11/50	10/10	[=====]	- 3s	270ms/step - loss: 7.3411e-04 - accuracy: 0.9668 - val_loss: 0.0151 - val_accuracy: 0.7429		
Epoch 12/50	10/10	[=====]	- 3s	272ms/step - loss: 5.3083e-04 - accuracy: 0.9648 - val_loss: 0.0152 - val_accuracy: 0.7143		
Epoch 13/50	10/10	[=====]	- 3s	270ms/step - loss: 7.5430e-04 - accuracy: 0.9707 - val_loss: 0.0147 - val_accuracy: 0.6857		
Epoch 14/50	10/10	[=====]	- 3s	271ms/step - loss: 6.1147e-04 - accuracy: 0.9398 - val_loss: 0.0152 - val_accuracy: 0.7429		
Epoch 20/50	10/10	[=====]	- 3s	273ms/step - loss: 6.0233e-04 - accuracy: 0.9795 - val_loss: 0.0150 - val_accuracy: 0.7429		
Epoch 45/50	10/10	[=====]	- 3s	272ms/step - loss: 7.2302e-04 - accuracy: 0.9210 - val_loss: 0.0144 - val_accuracy: 0.7714	Epoch 46/50	
Epoch 46/50	10/10	[=====]	- 3s	273ms/step - loss: 5.4603e-04 - accuracy: 0.9570 - val_loss: 0.0147 - val_accuracy: 0.6857		
Epoch 47/50	10/10	[=====]	- 3s			

274ms/step - loss: 5.9937e-04 - accuracy: 0.9238 - val_loss: 0.0144 - val_accuracy: 0.8000
Epoch 48/50 10/10 [=====] - 3s
274ms/step - loss: 6.7256e-04 - accuracy: 0.9039 - val_loss: 0.0155 - val_accuracy: 0.8000
Epoch 49/50 10/10 [=====] - 3s
272ms/step - loss: 9.3715e-04 - accuracy: 0.8818 - val_loss: 0.0149 - val_accuracy: 0.6857
Epoch 50/50 10/10 [=====] - 3s
270ms/step - loss: 7.7695e-04 - accuracy: 0.9380 - val_loss: 0.0155 - val_accuracy: 0.7714

VII. ARTIFICIAL NEURAL NETWORK (ANN)

Network of the interconnected neurons is called as Artificial Neural Network. Many algorithms are based on the Artificial neural network [5][6][7][8] ANN is also used for classifying the characters. Recognition of characters had been done for this paper of number plate identification. Perceptron with multiple layers model of ANN used for characters classification. Every layer is responsible for performing some tasks like as input layer helps in decision making, hidden layer sorts the tough computational tasks output layer produces the results. Training the data sets feed forward Backpropagation networks has used. Backpropagation training systems had been already proposed with the speed of 0.28 sec and by many others considers the variant speed [17]. Ambiguity between characters like the has been resolved by HNN

A. TEMPLATE MATCHING

Fixed sized characters have been observed with the template matching process. Template matching is using for facial detection, image processing and the medical field services also. Two main categories of the template matching are feature based matching and second one is the templet-based matching. For stronger image processing is being done the first method of image feature matching. For getting the characters to be matched more than 80% some statics methods used.

Many features extracted are based on the accurate training of the data sets. Adjusting of all the characters is being done with the normalization methods. Recognition rate 86% is achieved with 430 images. Support Vector Machine is used for different format background characters. We have used the low-resolution template for characters image recognition. Similarity of characters is being observed by the similarity function.

VIII. RESULT ANALYSIS

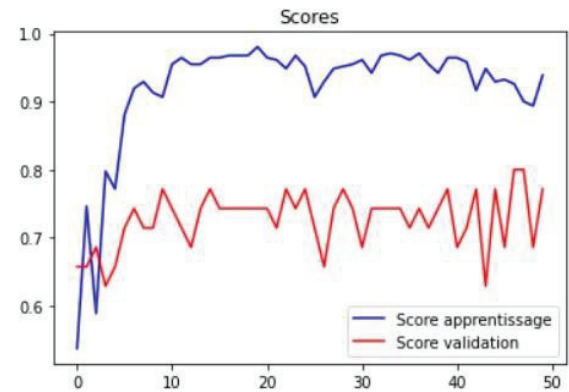


Fig. 3. Accuracy Score

Preprocessing steps of the character recognition is done by the segmentation method and recognizer should be able to handle the ambiguity of tilted characters. Good accuracy results have been recorded. Details of the parameters taken is summarized in the table. Better accurate results are getting recorded by the APNR rather than the OCR. Tesseract is also being utilizing for the better results. Language training data-based characters also been recognized by this method. By using such methods traffic security, suspicious activity identification easy to use, immediate information availability of the vehicles also been done effectively.

IX. CONCLUSION

There are algorithms available for Number Plate recognition purposes. Every Algorithms seems to be different accuracy and efficacy results. We have done the preprocessing steps of RGB to gray image conversion, elimination of jitter, image in to binary format etc during this implementation. Afterwards scanning of the license number plate has been detected. Recognition of characters is done by the CNN order by scanning the characters horizontally. Training is done to get the more accurate results so that characters can be read more precisely. Our implementation does the recognition of the number plate characters accurate and the policies framed by the government to maintain the traffic system smoothly. Number plates are scanning according to the policies framed by the government officials. It can be fruitful in such a cases where people are following the number plate required format along with the chip so that vehicle can be detected easily. By our implementation we can use it with the fancy character recognition, car model recognition, multilingual characters recognition etc.

X. SCOPE AND FUTURE WORK

Super Resolution is using for the character recognition

of the different back ground and color schemes and font size etc. Number plate systems recognizes the one number plate at a time but in real practices more than one plate would be exists at the time of the capturing of the images. Multiple number plate can be detected by the refined strategy. Currently we are scanning the number plate system this can be done for the checking the speed of the vehicles. Analysis is done by the us for captured images of the number plates but in future automatic number plate can also be detected automatically.

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