Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 07, July-2019

Zoning based Number Plate Recognition

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***Abstract*- In recent years, the number plate recognition system has been playing an important role in smart or metro cities for Intelligent Transportation System (ITS). This proposed method is mainly divided into four stages such as Pre-processing, Segmentation, Feature Extraction, and Recognition. The pre-processing stage involving the conversions of a color image into a grayscale image and further into the black and white image. The segmentation of characters is done by using vertical profile projections. The next stage is the feature extraction. In general, the human being can read the characters easily but computers can't classify without training to do so. This paper proposes two feature extraction techniques namely statistical features and zoning features. The main goal of these two combined features is to improve the accuracy of the system. The Statistical based features depends on area, shape, the perimeter of image and Zoning based feature extraction technique is to divide the input image into predefined zones and calculate the pixel density of the pattern. The K-NN and SVM classifiers are used to classify the characters and obtained the 91.2% and 94.5% recognition rate by using K-NN and SVM classifiers respectively.**

Keywords – Number plate, Segmentation, Statistical Features, Zone Features, Classifier, Recognition

I. INTRODUCTION

A number plate recognition gives a contribution to a large number of applications such as toll collection to check the vehicle tax, electronic payment system, catching the over speedy drivers, etc. There are some difficulties also during the recognition of characters such as the resolution of the image is poor. The pre-processing stage consists of the conversion operations. It helps to reduce the computational complexity of the system. The next step is the segmentation. Each character is separately extracted by using vertical projection analysis. From these segmented characters, the features are to be extracted by feature extraction process. There are many feature extraction methods in pattern recognition such as projection histograms, zoning, Zernike moments, statistical features, etc. This paper uses two features viz. statistical features and the zoning features. The main purpose of combining these two features is to improve the accuracy of the system. The final step is the recognition of the characters. The K-NN and Support Vector Machine (SVM) classifiers are performing recognition and classification tasks.

II. RELATED WORKS

There is a lot of work done in the number plate Recognition. The Pooya Sagharichi Ha et al. [20] proposed a method on Automatic License Plate Recognition using a canny edge and recognition by Template matching. Broumandia et al. [16] work on the Farsi license plate for segmentation of characters by vertical projections and recognition by the ANN classifier.

The Animesh Chandra Roy et al. [17] using the morphological approach and template matching for detection as well as recognition of the Bangla number plate. The M. M. Shidore [14] proposed method on the Indian number plate vehicle. In that, the segmentation of characters is done by vertical projection and classification using the SVM classifier. The Yusuf Parvej et al. [1] proposed a method of neural network for Handwritten English alphabet recognition. Sandeep Saha et al. [3] proposed optical character recognition using 40-point feature extraction and recognition by using the ANN classifier. Saleem Pasha et al. [2] proposed zoned based and morphological based feature extraction techniques for English alphabets recognized by the k-NN classifier. Rachana R. Herekar et al. [13] have proposed zoning using Euler number for English alphabets and numerals. The Gaurav Jaiswal et al. [18] proposed a method on handwritten Marathi character using statistical features and recognition by the ANN classifier. The Gaurav Jaiswal et al. [18] proposed a method based on Marathi characters using statistical features. The table1 shows the feature extraction techniques with their accuracy.

Table1. Literature Survey

Author	Feature Extraction	Classifier	Accuracy
Pooya Sagharichi Ha et al.[20]	Canny Edge Operator	Template Matching	71.43%
A.Broumandni a et al.[16]	Neural Network	CNN	93%
M.M.Shidore et al.[14]	Centroid	SVM	79.84%

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ISSN: 2278-0181
Vol. 8 Issue 07, July-2019

Animesh Chandra Roy et al.[17]	Morphol-ogical Features	Template Matching	88.8%
Yusuf Parvej et al.[1]	Neural Network	ANN	82.5%
Sandeep Saha et al.[3]	40-point features	ANN	83.84%
Saleem Pasha et al.[2]	Zoning and Morphol-ogy	K-NN and SVM	90.38% and 82.38%
Rachana Herekar et al.[13]	Zoning	Euler Number	91%
Gaurav Jaiswal et al.[18]	Statistical Features	Neural Network	87.38%

III. PROPOSED METHOD

The proposed method is comprised of four stages Pre-processing, Segmentation, Feature Extraction, and Recognition. The preprocessing stage results the black and white pixel image. The extraction or segment of each character from the pre-processed image is done in the segmentation stage. The next stage is feature extraction. This proposed method uses two features viz. statistical features and zone features. These features help in the recognition stage. In the Classification stage, the recognition rate is calculated by two classifiers K-NN and SVM. Figure1shows the block diagram of the character recognition system.

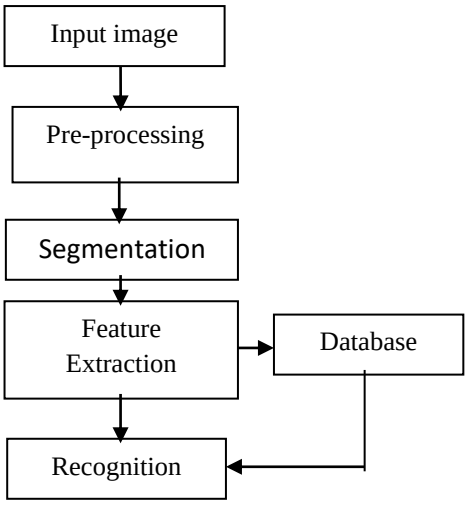

Figure1. Block Diagram of Proposed Number Plate Recognition System

A) Pre-processing

The pre-processing plays a crucial role in any proposed method. There are different terms in the pre-processing stage such as shown in figure2.

Figure2. Steps in Pre-processing

1) Input Image

The input image is the number plate of vehicle consisting of English alphabets and numerals. This proposed method work on the Indian number plate as shown in figure3.

Figure3. Number Plate

2) RGB to Grayscale:

The number plate contains the color image. This step converting the color image into a grayscale image as shown in figure4.

Figure4. Grayscale Image

3) Binarization

Now, the next step is to converting gray scale number plate into binary. Generally the grayscale image having 256 gray levels.

Figure5. Binary Image

By using thresholding, the values which are above the threshold (T) it is assign as '1' otherwise '0' as shown in the following equation.

$$\text{inew} = 1 \qquad pix(i,j) > T$$

$$inew = 0 \qquad otherwise$$

Where, T is thresholding and pix (i,j) is grayscale pixels. The figure5 shows the binary number plate.

B) Segmentation

Character separation from the number plate region is important step in number plate recognition. The goal of this step is to segmentation of characters from the number plate without losing features. This phase consists of the sequences of operation as follows:

a] Filtering

To remove the noise except characters from the number plate such as screws or black dots by using median filtering as shown in figure6.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
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Figure6. Filtered Image

b] Connected Component Analysis

In this step applying the labels to the connected pixel components in the image and retaining those component which is having maximum number of connected pixels. Firstly pass the assign temporary pixels to each foreground pixels. The result of connected component analysis as shown in figure7.

Figure7. Connected Components

c] Vertical Projection Profile

Then vertical projection profile is used to find the gaps between the characters and calculating the row and indices of each character and taking the inversion of each character. This method isolates every character on the number plate as shown in figure8.

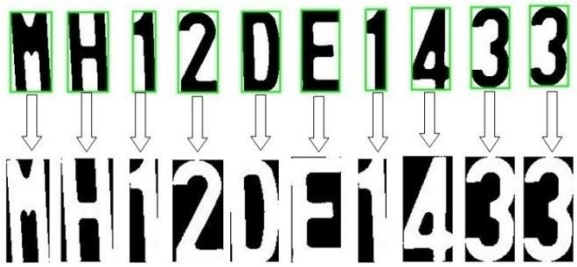

Figure8. Segmentation of characters

C) Feature Extraction

The image needs exact size for the feature extraction technique. By using thresholding value change the size of segmented character. It means that, size of segmented character is above or the threshold value it changes, for row it is 60 and 30 for column respectively. The resized image as shown in figure9.

Figure9. Resize Images

Feature Extraction process plays an important role in pattern recognition fields. The feature extraction process gives the relevant data from the segmented characters from the segmentation stage.

1. Statistical Based Feature extraction Method

In the area of Character recognition the statistical features are widely used. These are Area of Character, Perimeter, Equivalent diameter, Centroid, Branch and endpoints. All these are the binary object features extracting from the labeled image.

A] Area of Character

The segmented character is consisting of the labeled binarized image of size 60*30. The area of character is calculated by taking the total number of white pixels in that character image to obtain its mass value or area of that character.

B] Perimeter

The perimeter of the object can help us to locate in space and provide information about the shape of the object. It can be found by the number of '1' pixels and that have zero pixels.

C] Equivalent Diameter

The Equivalent diameter is the ratio of finding the number of elements in rows with respect to the circumference of that image.

D] Centroid

The centroid is calculated by the center of mass for the character region. The centroid consisting of two coordinates x and y whereas x is horizontal co-ordinate region and y is a vertical co-ordinate region. The centroid region is of white pixels.

$$x = \frac{size\ of\ M^{th} elements\ of\ character}{2}$$

$$y = \frac{size\ of\ N^{th}\ elements\ of\ character}{2}$$

E] Branch and Endpoints

The connectivity between the pixels region means the center of that pixel is assigned as a branch point and an endpoint the process is vice versa. The pixels value ends at the point it assigns as an endpoint.

2. Zoning Based Feature Extraction Method

In the field of character recognition, image zoning is widely used. The zoning method gives valuable information about the local characteristics of the character pattern. After the segmentation stage the each image is resized by using thresholding and then it is given to feature extraction stage. The size of image is (60×30) and Partition this images into M*N zones as shown in figure10.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 07, July-2019

Figure10. Zoning on characters

Let ZM= $z_1, z_2, z_3, \ldots . z_m$ be a zoning method. The size of each zone is (20×10) then calculating the pixel density of each zone. The partitioned of image into nine zones resulting the feature vector of size(1×9).

Pseudocode of Zoning

1. Input: Segmented Binary Image (size 60*30)
2. New block = 1
3. for i = 1:3
4. for i = 1:3
5. read 20*10 pixels in a matrix format
6. block [New block] = read matrix
7. New block=New block + 1
8. for New block = 1:9
9. read block [New block]
10. count = number of white pixels in the block
11. signature array [New block] = count
12. Result: signature array of the image

D. Classification

The character classification is a challenging topic in pattern recognition for useful applications. The classification stage classifies on the basis of features. The input for a classification stage is the features and it gives class whereas the input class belongs to which pre-trained class. This proposed method were checking the accuracy rate by using two classifiers K-NN and Support Vector Machine (SVM).

1) K-Nearest Neighbor (K-NN)

It is more widely used in the classification problem in pattern recognition. The working of KNN is to calculate the distance between the test data and each row of training data. The Euclidean distance as the distance metric which is represented as:

$$\text{Euclidean } (x^p, y^p) = \sqrt{\sum_{i=1}^{f}(x_i - y_i)^2} \qquad (1)$$

Where, f representing the number of features. This classifies on the basis of the minimum distance between the test feature vector and the trained feature vector.

2) Support Vector Machine (SVM)

The Support Vector Machine (SVM) is mostly used for pattern recognition as well as regression tasks. It is a binary classification on the basis of hyper plane to maximize the margin separating the data into classes. The SVM is used for pattern classification problems. The multiclass classification is solved by extending the binary classification. The SVM model consists of trained data and testing data. The training data consisting of target value and some attributes or features. The purpose of SVM is predicted target values of the data set in the testing data set. The linearly scaling each attribute to the range [0 1]. Given a training set of instance label pairs (x_i, y_i); i=1…..l where $x_i \in R^n$ and y $\in \{1\ -1\}^l$, the SVM requires the following optimization problem:

$$\min_{w,b,\xi} = \frac{1}{2} w^T w + C \sum_{i=1}^{l} \xi_i$$

Subject to $y_i\ (w^T \phi(x_i)+b) \geq 1- \xi_i \xi_i > 0$ …….(2)

Here the training vectors x_i is mapped into higher dimensional space function is ϕ. Maximizes the distance between the nearest examples of both classes is done by an optimal layer margin. These nearest examples are also called support vectors. C > 0 is the penalty parameter of the error term. Furthermore, K $(x_i, x_j) = \phi\ (x_i)^T \phi\ (x_j)$ is called kernel function. The radial basis function is used which is given by

$$K\ (x_i, x_j) = e^{(-\Upsilon ||x_i - x_j||)},\ \Upsilon > 0 \qquad \ldots\ldots\ldots\ldots\ldots(3)$$

A search is applied to find the value of Υ which is the parameter of RBF. The value of both variance parameters is selected in range (0, 1) for gamma Υ and (0, 1000) for the cost (c) for support vectors and examines rate.

IV. EXPERIMENTS AND RESULTS

a) Data Collection

The collection of characters or the database is the first step in any character recognition system. The collected database mainly consists of 18236 images of alphabets as well as numerals and the size of each image is $128 \times 128 \times 3$.

b) Results

The performance of the system depends on the correct recognition and classification of the number plate. This proposed method tested 50 images of number plates and 41 number plates with some characters of remaining number plate were recognized. The results were comparing by two classifiers K-NN and Support Vector Machine (SVM). This proposed method tried to improving the recognition rate from the previous works. The comparative analysis with the proposed method as shown in Table2 and result of recognized number plate as shown in figure11.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 07, July-2019

Figure11. Result of Recognized Number Plate

Table2. Comparative Analysis

Author	Features	Classifier	Accuracy
Pooya Sagharichi Ha et al.[20]	Canny Edge operator	Template Matching	71.43%
A.Broumandnia et al.[16]	Neural Network	CNN	93%
M.M.Shidore et al.[14]	Centroid based Features	SVM	79.84%
Animesh Chandra Roy et al.[17]	Morpholog-ical Features	Template Matching	88.8%
Yusuf Parvej et al.[1]	Neural Network	CNN	82.5%
Sandeep Saha et al.[3]	40-point features	ANN	83.84%
Saleem Pasha et al.[2]	Zoning and Morphology	KNN and SVM	82.38% and 90.38%
Rachana R. Herekar et al.[13]	Zoning	Euler Number	91%
Gaurav Jaiswal et al.[18]	Statistical Features	ANN	87.38%
Proposed Method	Statistical and Zoning	K-NN and SVM	91.2% and 94.5%

V.CONCLUSION

This proposed method work on the number plate recognition. This method was mainly three steps for recognizing the number plate. Segmentation of character from the number plate by using vertical projection profile and then features are extracted from each character by using two features statistical and zoning features. The purpose of the combining these two features for increasing the accuracy of the system. There are 18236 characters are trained in the database. At the time of the recognition task, the taste image of segmented each feature vector is compared with the each feature vector in the database. In this paper we have taking 50 number plate images out of them 41 number plates and some characters of other plate were properly recognized. The recognition rate is discussed with the two classifiers K-NN classifier getting 91.2% accuracy and by SVM classifier 94.5% accuracy. In the future, we would like to achieve a higher recognition rate by using various fusions for various scripts.

REFERENCES

1. "Neural networks for handwritten English alphabet recognition." Perwej, Yusuf, and Ashish Chaturvedi. *arXiv preprint arXiv:1205.3966* (2012).
2. "Zone Based and Morphological Based Feature Extraction Techniques for English Alphabets." Pasha, Saleem, et al. *(IJCSIT) International Journal of Computer Science and Information Technologies* 6.3 (2015).
3. "Optical Character Recognition using 40-point Feature Extraction and Artificial Neural Network." Saha, Sandeep, et al. *International Journal of Advanced Research in Computer Science and Software Engineering* 3.4 (2013).
4. "Diagonal based feature extraction for handwritten character recognition system using a neural network." Pradeep, J., E. Srinivasan, and S. Himavathi. *2011 3rd International Conference on Electronics Computer Technology*. Vol. 4. IEEE, 2011.
5. "Handwritten Marathi basic character recognition using the statistical method." Kamble, Parshuram M., and Ravindra S. Hegadi. *Emerging Research in Computing, Information, Communication, and Applications* 3 (2014): 28-33.
6. "Zoning based Devanagari character recognition." Murthy, OV Ramana, and M. Hanmandlu. *International Journal of Computer Applications* 27.4 (2011): 21-25.
7. "Zone-based features for handwritten and printed mixed Kannada digits recognition." Dhandra, B. V., Gururaj Mukarambi, and Mallikarjun Hangarge. *IJCA Proceedings on International Conference on VLSI, Communications, and Instrumentation (ICVCI)*. No. 7. 2011.
8. "Marathi numeral identification system in Devanagari script using discrete cosine transform." Vaidya, Madhav, Y. V. Joshi, and Milind Bhalerao *Int. J. Intell. Eng. Syst* 10.6 (2017): 78-86.
9. "Combined classifier approach for offline handwritten Devanagari character recognition using multiple features." Bhalerao, Milind, et al. *Computational Vision and Bio Inspired Computing*. Springer, Cham, 2018. 45-54.
10. "Discrete Cosine Transform-Based Feature Selection for Marathi Numeral Recognition System." Vaidya, Madhav, et al *Advances in Computer Communication and Computational Sciences*. Springer, Singapore, 2019. 347-359.
11. "Frequently Used Devanagari Words in Marathi and Pali Language Documents." Bhalerao, Milind, Sanjiv Bonde, and Madhav Vaidya. *Advances in Computer Communication and Computational Sciences*. Springer, Singapore, 2019. 97-110.
12. "Marathi numeral recognition using statistical distribution features." Vaidya, Madhav V., and Y. V. Joshi. *2015 International Conference on Information Processing (ICIP)*. IEEE, 2015.
13. "Handwritten character recognition based on zoning using Euler number for English alphabets and numerals." Herekar, Rachana R., and S. R. Dhotre. *IOSR Journal of Computer Engineering* 16.4 (2014): 75-88.
14. "Number plate recognition for indian vehicles." Shidore, M. M., and S. P. Narote. *IJCSNS International Journal of Computer Science and Network Security* 11.2 (2011): 143-146.
15. "Vehicle license plate segmentation in natural images." Cano, Javier, and Juan-Carlos Pérez-Cortés. *Iberian Conference on Pattern Recognition and Image Analysis*. Springer, Berlin, Heidelberg, 2003.
16. "Application of pattern recognition for Farsi license plate recognition." Broumandnia, A., and M. Fathy. *ICGST International Journal on Graphics, Vision and Image Processing* 5.2 (2005): 25-31.
17. "License plate detection and character recognition system for commercial vehicles based on morphological approach and template matching." Roy, Animesh Chandra, Muhammad Kamal Hossen, and Debashis Nag*2016 3rd International Conference on Electrical Engineering and Information Communication Technology (ICEEICT)*. IEEE, 2016.
18. "Handwritten Devnagari character recognition model using neural network." Jaiswal, Gaurav. *International Journal of Engineering Development and Research, pg* (2014): 901-906.
19. "An efficient license plate recognition system using convolution neural networks." Lin, Cheng-Hung, Yong-Sin Lin, and Wei-Chen Liu*2018 IEEE International Conference on Applied System Invention (ICASI)*. IEEE, 2018.
20. "License Plate Automatic Recognition based on edge detection." Ha, Pooya Sagharichi, and Mojtaba Shakeri *2016 Artificial Intelligence and Robotics (IRANOPEN)*. IEEE, 2016.
21. "The automated parking fee calculation using license plate recognition system." Yimyam, Worawut, and Mahasak Ketcham. *2017 International Conference on Digital Arts, Media and Technology (ICDAMT)*. IEEE, 2017.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 07, July-2019

22. "A new class of detail-preserving filters for image processing." Nieminen, Ari, Pekka Heinonen, and Yrjo Neuvo. *IEEE Transactions on Pattern Analysis and Machine Intelligence* 1 (1987): 74-90.
23. "License Plate Recognition by Fuzzy Logic." Nijhuis, J. A. G., et al. *Proceedings of the 5th Aachener Fuzzy Symposium*. 1995.
24. "Robust edge detector based on morphological filters." Song, Xudong, and Yrjö Neuvo. *Pattern Recognition Letters* 14.11 (1993): 889-894.