Advances in Parallel Computing Algorithms, Tools and Paradigms
D.J. Hemanth et al. (Eds.)

doi:10.3233/APC220077

Damaged Licensed Number Plate Detection Based on Novel Object Oriented Classification with K-Means Algorithm

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Abstract. The aim is to detect the quality of number plates using object oriented classification in comparison with K-Means clustering. Two groups such as novel Object Oriented Classification and K-Means algorithm are applied. Total number of samples that are evaluated on this proposed methodology are 265 images. Among this sample dataset, 185 images [70%] of the dataset was taken as a training dataset and 80 [30%] was taken as a testing dataset. Programming experiment was carried out for N=7 and N=9 iterations for novel Object Oriented Classification and K-Means algorithm respectively. Computation processes were executed and verified for exactness. SPSS was used for predicting significance value of the dataset considering G-Power value as 80%. Novel Object Oriented Classification algorithm shows a high accuracy and homogeneity for damaged number plate detection, and has recognition rate of 0.593 ($p>0.05$). This research article is intended to implement an innovative approach to Automatic License Plate Recognition for detection of damage in licensed number plates. Comparison results show that efficiency of Novel Object Oriented Classification is better than K-means Algorithm for detecting damaged number plates.

Keywords: Image Processing, Novel Object Oriented Classification, K-Means Algorithm, Automatic Number Plate Recognition, Clustering, Image segmentation

1. Introduction

Every car is recognizable by its number plate everywhere around the world. One of the available automated video surveillance systems for detecting number plates is number plate detection. If the number plates are broken, there is insufficient lighting, or the images are indistinct, the system will fail.Thus an efficient methodology is provided to recognize such damaged number plates. Automatic License Plate Recognition (ANPR) Camera Devices provide excellent performance when trained over Millions of License Plates. ANPR camera device is efficient in reading license plates with high accuracy even in difficult environmental conditions [1]. In automated transportation systems, image is regarded to be a critical stage for car recognition and identification. It has a

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big influence on how well an automated transportation system works [2]. Fuzzy logic is applied to the platform of locating a number plate in digital plate in digital images of cars. The intention of work is to show capability of fuzzy logic in this field**.**

There are 8 exploration articles published in IEEE Xplore and around 1700 articles found by Google researchers. A complete performance comparison of several real-time tested and simulated algorithms, including those employing computer visions, was made, with a detailed assessment of current methodologies and improvements in ANPR systems [3].Character detection is one of the important image processing techniques which are commonly used in Smart transportation systems.

The study on different algorithms used in detection of vehicle number plate was done using deep learning algorithms[4]. As a result, a practical approach for identifying damaged number plates is presented. The detection of vehicle license number plates has a wide range of applications, including traffic management, security, and toll gates, etc. The color, texture, size, language, and geographic location of number plates differ from country to country. A variety of methodologies, methods, and algorithms are employed [5]. Because every vehicle has a number plate as part of its identity, vehicle number plate recognition and detection is an essential aspect of an Intelligent Transportation System (ITS).To investigate all of these unlawful acts, vehicle monitoring is frequently essential [6]. It has been concluded that various techniques of car Automatic Number Plate Recognition (ANPR) is a mass surveillance technique that employs optical character recognition on photographs to track down license plates on moving cars [7]. Most of us keep documents of vehicles in the vehicle itself, which is extremely dangerous in the event of theft. It is not safe to carry vehicle papers to all places today's world [8].

The K-Means algorithm has an important property of converging solution in a faster manner when comparing other clustering techniques. But the only drawback is that the solution may not beoptional. And also the solution quality depends on the cluster set initialized first and the value of K. Existing literature shows the lack of accuracy in predicting damages in licensed number plates. So the aim is to predict the damaged license plate using Novel Object Oriented and K-means algorithms with improved accuracy by removing outliers in the data set which are considered a major reason for defective results of the model. The aim is to improve accuracy rate and homogeneity in prediction and detection of damaged number plates

2. Materials and Methods

The number of groups used for the study is 2. Group 1 is novel Object Oriented Classification and group 2 is K- means algorithm. Sample size was calculated using clinical analysis, 7 sample sizes are estimated per group and totally 15 sample sizes as per sample size calculator with 95% confidence interval and 80% pretest power and 1 as enrollment ratio [1].

2.1. K-means Algorithm

It is an iterative technique of image processing that helps tomake K clusters on an image.The K cluster centers at random are selected and each pixel in the image is allocated to the cluster closest to it depends on similarity characteristics like Euclidean

distance of intensity. By averaging all of the pixels in clusters, recalculate cluster center for new clusters. The steps outlined above are repeated until convergence is achieved.

A scale-invariant feature transform (SIFT)-based method is used to automatically identify the ideal K value. It entails estimating the height of characters on license plates. Horizontal projection histogram, vertical edge detection and color reverse and are three aspects of this process. The license plates of the state of New South Wales (NSW), Australia, come in a variety of formats, colours, and alignments. White in black, black in white, black in yellow, and other colour pairings are common. Before assigning the correct colour (black) to characters on a license plate and thus obtaining an accurate binary picture of the license plate, a colour reserve step is required. The characters on a licence plate go black as a result of this. It's done with the use of statistical edge analysis. A horizontal symmetrical line is selected on the licence plate image based on the location image. The average number of cross points along each line in the horizontal direction is used to determine the colour index C1. A fundamental area enlargement computation is employed after detecting and finding a rectangular portion of the license plate to verify that the enlarged area fully contains the license plate.

2.2. Object Oriented Classification

The novel object oriented classification method helps in decomposing the complex images into many simple spatial structure scenes. According to homogeneity, images can be divided into complex coverage and single coverage type scenes. Various steps involved in this novel object oriented classification are read the image and convert to gaussian blur then it will change to grayscale. Then binarize images. Next is to label binary images using n-8 Connected Components Algorithm. Finally remove too large, too small regions and regions whose aspect ratio is >1.

2.3. Statistical Analysis

The statistical software used for our study is the IBM SPSS tool. The independent variable is image number and other attributes such as grayscale intensity are dependent variables considered for this work. These variables help in preprocessing of number plate images and detection of damaged number plates. In SPSS, the dataset is prepared using 7 and 9 iterations, in each algorithm. Independent samples T test analysis is carried out in this research study.

3. Results

Table1 shows descriptive statistics for accuracy in both algorithms Object Oriented Classification and K-Means. Table 1 also shows group statistics which gives the accuracy mean of 0.6943 for Object Oriented appears to be more when compared with K-means which has only0.3956 Standard deviation (SD) and mean errors are calculated. Standard error means for object oriented Classification is 0.00719 and K-means is 0.06774.

Table 1.T-test comparison, Group Statistical analysis between Object Oriented Classification and K-means algorithm.

	Group	N	Mean	SD	Std.Mean Error
Homogeneity	Object Oriented Classification	7	0.7500	0.15895	0.06008
	K-means Algorithm	9	0.4978	0.15312	0.05104
Accuracy	Object Oriented Classification	7	0.6943	0.01902	0.00719
	K-means algorithm	9	0.3956	0.20323	0.06774

Table 2 shows Independent sample test analysis, which shows comparison of mean accuracy and homogeneity. Significant value for homogeneity is 0.593 ($p>0.05$). The performance of the proposed object oriented is better than K-Means algorithm. Figure 1 shows the comparison of mean accuracy and homogeneity in bar graph.

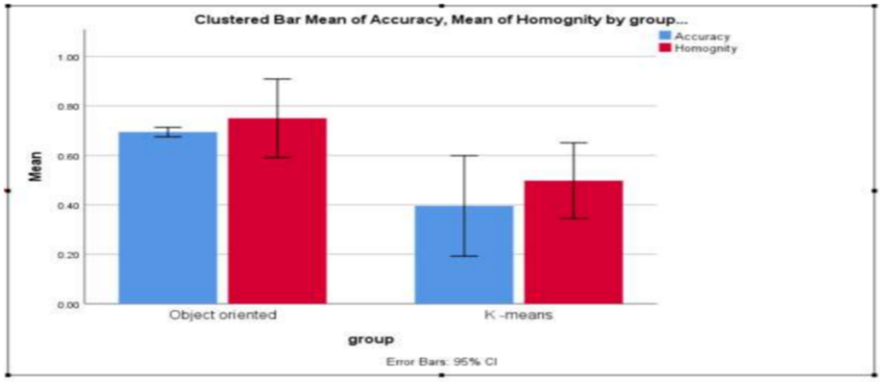

Figure 1. Bar graph of K-Means algorithm and object oriented classification in terms of mean accuracy and homogeneity.

4. Discussion

According to the results in table 2, Object Oriented classification has a better image detection quality than the K-Means approach whose p is less than 0.001 when performing Independent Sample T Test. Bar graph shows the comparisons of K-Means algorithm and object oriented classification in terms of mean accuracy and homogeneity. Mean accuracy of k-means is 39% and object oriented classification is 69%. Homogeneity of object oriented is 75% when compared to k- means with homogeneity 49%. Plate number recognition was made using optical character recognition [9]. The work uses mean shift value in finding accurate number plates [10]. The platform for locating number plates in digital plates in digital photos of autos uses fuzzy logic. There are no similar findings relevant to this work. The images identified by novel Object Oriented classification are better than K-Means algorithm. This method is suitable for detection of number plate images and this may be extended into any kind of images with different types of resolution.

Table 2. Independent Samples T test for Object oriented classification and K-means algorithm statistical significance of 0.593 (2-tailed) considering homogeneity of variance and statistical significance of 0.001 (2-tailed) considering accuracy

			F	**Sig**	**t**	**df**	**Sig (2-tailed)**	**Mean difference**	**Std Error Difference**	**Lower**	**Upper**
Accuracy	Homogeneity	Equal Variances assumed	0.010	0.9205	0.545	18	0.593	0.07200	0.13223	0.20580	0.34980
		Equal Variances not assumed			0.545	17.999	0.593	0.07200	0.13223	0.20580	0.34980
	Accuracy	Equal Variances assumed	2.310	0.146	12.840	18	0.001	0.10700	0.00833	0.00833	0.12451
		Equal Variances not assumed			12.840	15.397	0.001	0.10700	0.00833	0.00833	0.12472

5. Conclusion

In this research, results show that accuracy of novel Object Oriented Classification has better mean accuracy of approximately 0.6943 and homogeneity of 0.7500 in comparison with K-Means Algorithm having accuracy of 0.3956 and homogeneity of 0.4978, for removal of noise and smoothening of image which leads to better detection of damaged licensed number plate. The discussion of previous research articles also proves that Novel Object Oriented Classification has better accuracy than K-Means Algorithm in terms of homogeneity and accuracy.

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