AN EFFICIENT APPROACH TO DETECT DAMAGED NUMBER PLATE WITH THE REGION OF INTEREST USING CONVOLUTIONAL NEURAL NETWORK OVER NAIVE BAYES NETWORK

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Abstract

Aim: To detect the damaged number plates with ROI (Region of Interest) using advanced Convolutional Neural Networks (CNN) and comparing them with NBC (naive bayes network).
Materials and Methods: Classification is performed by Novel Convolutional Neural Networks (CNN) (N=10) over (NBC) naive bayes network (N=10). Sample size is calculated using Gpower with a pretest power as 0.8 include alpha value 0.05, beta value 0.2.
Results: Mean accuracy of the Novel Convolutional Neural Networks is (96.40%) is high compared to naive bayes network of (93.30%). Significance value for accuracy and loss is 0.01 (p>0.05)
Conclusion: The Mean Accuracy of damaged number plate in Novel Convolutional Neural Networks is better than the naive bayes network.

Keywords: Deep Learning, Novel Convolutional Neural Network, Naive Bayes Network, Number Plate, Vehicles.

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1. Introduction

With increasing population, the quantity of vehicles on roads is additionally increasing and so it's terribly troublesome to enforce laws and traffic rules manually for swish traffic flow (Stepinski, Uhl, and Staszewski 2013). Traffic management systems are put in on freeways to check for vehicles moving at speeds not permissible by law (Stauffer and Bonfanti 2006). All these processes have a scope of improvement. In the centre of these systems may be a vehicle. so as to modify these processes and build them simpler, a system is required to simply establish a vehicle (Nagar et al. 2021). so an automatic range plate recognition system (ANPR) was introduced, where many contributed their concepts to observe the quantity plate.Technology has improved in such the simplest way that the quantity plates are often recognised below any circumstances like poor illumination, inclementness (Ganguli 2020).

The articles published on detecting damaged number plates for the past five years were around 502. The usage of vehicles is increasing just because of the increase in population. All the vehicles throughout the world are differentiated by the number plate (Giurgiutiu 2014). Vehicle number plate identification is one of the major tasks in controlling traffic and video surveillance network systems (Jayakumari et al. 2020). The important phase of any kind of automobiles number identification model is to initially trace the numbers on the plate. The number of automobiles increased on the way due to industrial and economic growth (National Research Council et al. 1996). The number of automobiles increases the traffic directions violations, unpredicted accidents, traffic-related crimes.The identification number plateis one of the existing systems which are utilized for identifying numbers on the number plates (Rivas-Lopez, F., and Sergiyenko 2017). But his method is not suitable when the number plates are damaged, less illumination, or blur images. So, here is a new method introduced to overcome the above-mentioned issues. This method consists of certain states such as recognition, segmentation, localization, and pre-processing. The complete model includes capturing the picture, ignoring the background, and detecting the noise, editing the number plates, and then recognition of the characters then segmentation. In this research, two Deep Learning algorithms are used to develop the model for identifying numbers in the vehicle's number plate detection (Hingston 2007).

Our institution is passionate about high quality evidence based research and has excelled in various domains (Vickram et al. 2022; Bharathiraja et al. 2022; Kale et al. 2022; Sumathy et al. 2022; Thanigaivel et al. 2022; Ram et al. 2022; Jothi et al. 2022; Anupong et al. 2022; Yaashikaa, Keerthana Devi, and Senthil Kumar 2022; Palanisamy et al. 2022). The existing system of To detect the damaged number plates has a disadvantage of lesser prediction and accuracy rate. Finding a prediction model to exactly detect the damaged number plate detection is difficult. The on top of problem's quality is reduced once a model is made. Despite the indisputable fact that several researchers have discovered varied prediction models, several of them square measure unable to accurately To detect the damaged number plates. The application of damaged number plates are vehicles, scanner, sensores, monitor, ect. The aim of this proposed work is to create a model to detect the damaged number plate detection using Novel Convolutional Neural Networks, thereby improving accuracy and reducing time complexity (Wang et al. 2020).

2. Materials and Methods

This study setting was done in the Machine Learning Lab, Saveetha Institute of Medical and Technical Science (Mantouka et al. 2019). Sample size for this project is 20 (Group 1=10, Group 2=10). To detect the damaged number plates to modify the problem of low accuracy rate Novel Convolutional Neural Networks and Naive Bayes network is used. Novel Convolutional Neural Networks learns user preference and to detect the damaged number plates accordingly (“Judge Allows Access Suit about Parking to Continue” 2018). Naive Bayes network enables thorough exploration of diverse data present. Mean accuracy of Novel Convolutional Neural Networks is 99.47%. Mean accuracy of Naive Bayes (NB) algorithm is 89.28%. Dataset for this article is collected with 4 attributes and 1274 rows.

The number identification model allows the user to secure their parking area with unknown persons, monitor people, and access it automatically (Oecd and OECD 2017). Here CNN and NB approaches are used to develop for identifying numbers on the vehicle number plates.

In this current situation, various kinds of new technologies are developed and these techniques are used by various domains. Among the various techniques, Artificial Intelligence and Deep Learning are important techniques. Now, Deep Learning is an important technique in various applications due to its major ability to design different critical types of data like videos, images, and signals. CNN is the major Deep Learning model to identify pictures, time-related

information, and series of signals (Chen and Jain 2019).

Commonly used in the number plate identification system, the Novel Convolutional Neural Network model contains four pooling type layers and two various fully connected type layers. The input of the Novel Convolutional Neural Network model is a number plate image. After the convolutional layer, the given model generates the feature map. Then the feature map is given to another convolutional and polling type layer. ReLU is considered as the activation method and the softmax is called the output method (Brownlee 2019).

Pseudocode of Conventional Neural Network

1: Algorithm Parallel-CNN
2: input: d: dataset, 1: dataset true labels, W: Word2 Vec matrix
3: output: score of Parallel-CNN trained model on test dataset
4: let f be the featureset 3d matrix
5: for i in dataset do
6: let fi be the featureset matrix of sample i
7: for j in i do
8: Vj ← vectorize(j, w)
9: append v; to fi
10: append f; to f
11: ftrain, ftest, Itrain, ltest split feature set and labels into train subset and test subset
12: M Parallel-CNN (ftrain, Itrain)
13: score evaluate (i, ltest, M)
14: return score

The Naive Bayes Network model is selected for identifying numbers on the number plates because of the nature of the working process to implement and train the algorithms without arguments (Chen and Jain 2019; Li, Tang, and Gao 2019). Based on the Bayes approach, the posterior probability of the particular class C_i is computed by the equation.

Pseudocode for Naive Bayes Network

Input

Training dataset T,
F= (f1, f2, f3,.., fn) in testing dataset. // value of the predictor variable
Output:
A class of testing dataset.
Step:
1. Read the training dataset T;
2. Calculate the mean and standard deviation of the predictor variables in each class;
3. Repeat
Calculate the probability of fi using the gauss density equation in each class;
Until the probability of all predictor variables (fi, f2, f3,.., fn) has been calculated.
4. Calculate the likelihood for each class;
5. Get the greatest likelihood;

The hardware setup was an intel core i5 processor with a RAM size of 4GB. The system type used was a 64-bit, OS, X64 type processor with an HDD of 917 GB. The OS(Operating System) used was Windows and MATLAB software tools.

STATISTICAL ANALYSIS

The Statistical analysis was done using the IBM SPSS tool for both NBC and CNN algorithms for analyzing data. For both the proposed and existing algorithms, 10 iterations were executed and for every iteration, the forecasted accuracy value was noted for analysis in the SPSS based tool. The dependent kind variables are accuracy and independent identifiers are number width, height, and size of the image.

3. Results

The accuracy rate of the CNN model in number detection on the number plates has expressively increased because of a training data model. It is noted that the accuracy rate is changed from CNN to NBC as demonstrated in Fig. 1. The mean value and standard deviation value of accuracy retrieved from the proposed study are illustrated in Table 2. This work illustrates the NBC model with less accuracy and CNN have an extra important accuracy rate of 96.436% for number identification in the number plate. 3 of 11 Accuracy computation is processed with the help of the CNN model.

Table 1 labels the percentage rate of accuracy value retrieved among CNN and NB at every iteration with a mean value accuracy rate of 96.436 for CNN and 93.33 for KNN. The outcome is computed by relating the result with the Accuracy values using CNN and NB. Figure 2 demonstrates the mean accuracy rate of CNN and NB models.

The data collected from every iteration are tabularized depending on an independent sample T-test where there is a statistical-based significance value detected as 0.886 and the collected values are represented in Table 3.

4. Discussion

Due to the population, automobile users face various types of problems like traffic rule violations, security issues, vehicle robbery, etc. Identifying numbers on the number plate detection

may be developed to avoid the issue of an efficient vehicle management system ((Chen and Jain 2019; Li, Tang, and Gao 2019)). The recognition of number plate detection from collected pictures is broadly considered over past decades. The importance of this technique in safety and marketable usage varies from control traffic to parking administration and tracking the vehicles. Common number identification contains two stages: Identification and recognition (Maged Wafy and Ahmed M.M. Madbouly).

LPD and LPI techniques produce a 97.5 success rate value and 92.8% for recognition. The total time needed to identify the corner level point is 0.15 seconds and the identification of the number plate is 0.3 seconds (Poulkov 2019). Modified GrabCut technique, the value of localization accuracy rate is verified through 500 vehicle images with number plate detection from various countries. The accuracy rate of 99.8% is obtained from the vehicle number identification localization process (Maurer et al. 2016).

This proposed work also limits only to few numbers datasets and fewer arguments for deliberations. But in the next level, the equivalent work will be enhanced by having low calculations and changing the total arguments using different kinds of Deep Learning models.

5. Conclusion

This research, damaged of number plate detection is performed using the number plate dataset for Convolutional Neural Network and Naive Bayes Network. Real-time identification of numbers is important for monitoring vehicles, avoiding traffic and accidents on the road. The accuracy value of the CNN classifier is 96% whereas the accuracy value of NBC is 93%. The damaged number plate detection and accuracy using CNN appears to be better than NBC.

Declarations

Conflicts Of Interest

No conflicts of interest in this manuscript.

Author Contributions

Author JK was involved in data collection, data analysis, data extraction, manuscript writing. Author AJ was involved in conceptualization, data validation, and critical review of the manuscript.

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Tables and Figures

Table 1 Accuracy Rate percentage achieved at each iterations of Convolutional Neural Network and Naive Bayes Network with Mean accuracy of 96.40 for CNN and 93.30 for NBC

Sample (N)	Dataset size / Rows in %	CNN algorithm Accuracy in %	NB algorithm Accuracy in %
1	1274	96.40	93.30
2	1212	96.20	93.00
3	1189	96.00	92.75
4	1090	95.75	92.40
5	1010	95.40	92.00
6	998	95.00	91.75
7	950	94.75	91.40
8	906	94.40	91.00
9	878	94.00	90.75
10	719	93.75	90.40

Table 2. Group Statistic analysis, representing Conventional neural network and Naïve Bayes

Algorithm	N	Mean	Std. Deviation	Std.Error Mean
Accuracy	10 10	95.1650 91.8750	.93305 .98890	.29506 .31272
Error	10 10	4.8350 8.1250	.93305 .98890	.29506 .31272

Table 3. Independent Sample Tests results with confidence interval as 95% and level of significance as 0.05 (Conventional neural network appears to perform significantly better than Naïve Bayes with the value of p=0.886)

Accuracy	F	Sig.	t	df	Sig	Mean Difference	Std. Error Difference	95% Conf. Interval Lower	95% Conf. Interval Upper

Accuracy Equal variances assumed	.021	.886	7.652	18	.001	3.29000	.42994	2.38673	4.19327
Equal variances not assumed			7.652	17.94	.001	3.29000	.42994	2.38651	4.19349
Error Equal variances assumed	.021	.886	-7.652	18	.001	-3.29000	.42994	-4.19327	-2.38673
Equal variances not assumed			-7.652	17.94	.001	-3.29000	.42994	-4.19349	-2.38651

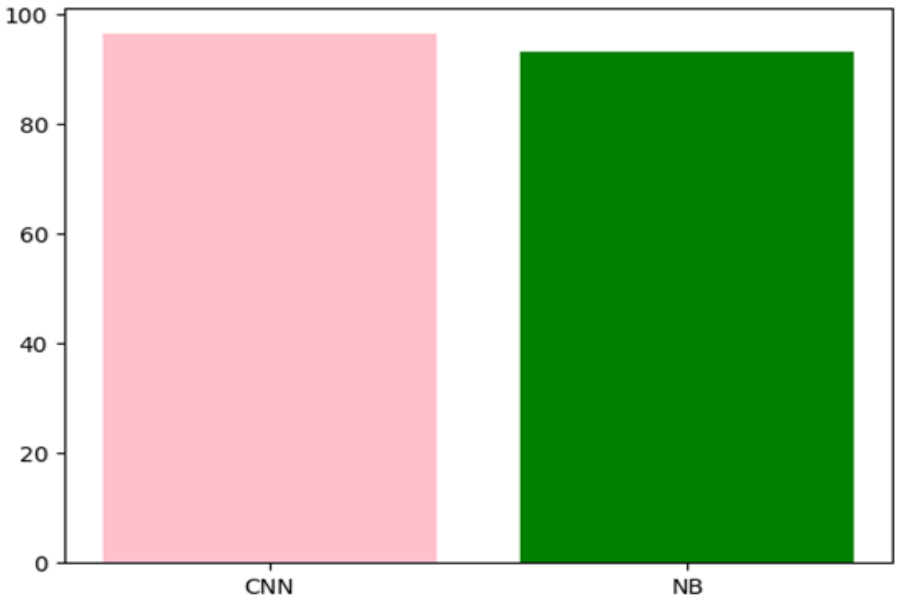

Fig. 1. Comparison between CNN and NB. The pink color curve represents the CNN (96.40) and the green curve color represents the NB (93.30) algorithm.

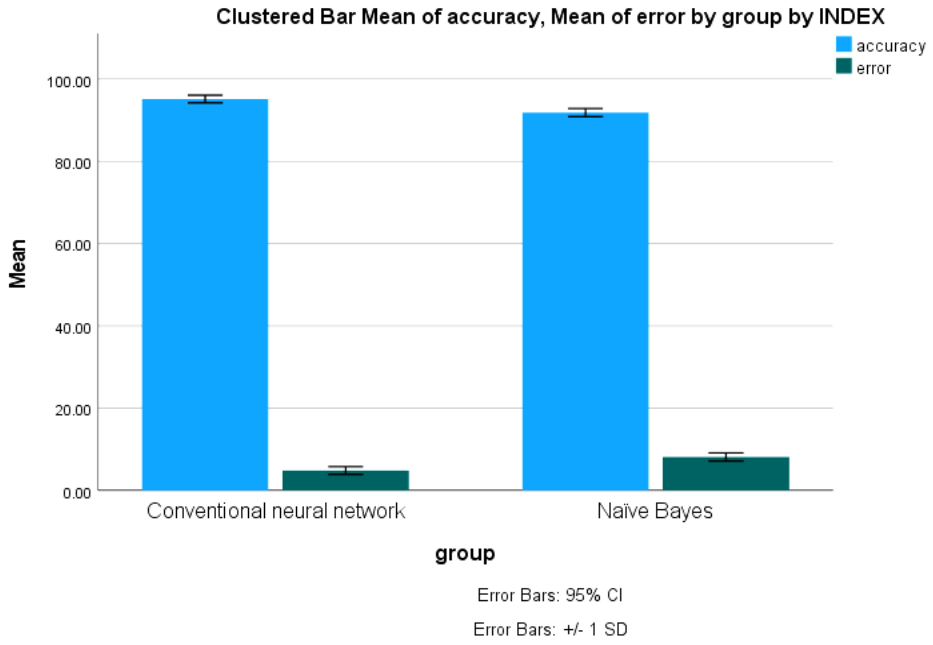

Fig. 2. Bar chart comparison of proposed CNN and NBC algorithm. Mean Accuracy rate of CNN is better than NBC.X-Axis:CNN vs NBC and Y-Axis: Mean Accuracy, SD +/- 1.